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FINAL REPORT ON FINISH AND COATING DEVELOPMENT FOR MAULER WEAPON POD

by

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and
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July 1965

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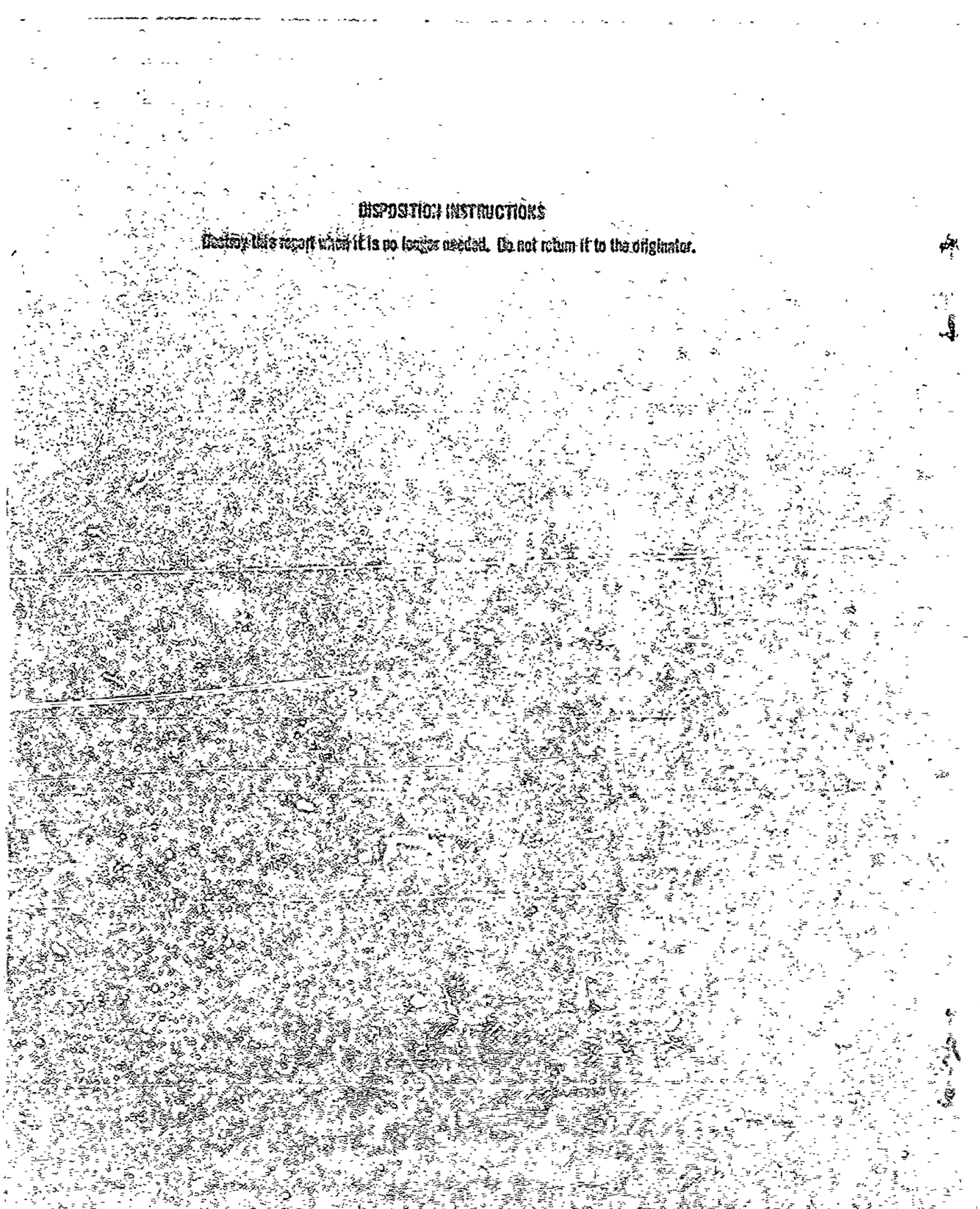

1 July 1965

REPORT NO. RI-TM-65-6

FINAL REPORT ON FINISH AND COATING DEVELOPMENT FOR MAULER WEAPON POD

by

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and

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DA Project No. 5286.12.117

AMC Management Structure Code No. 5262.12.11700

Container Design Branch
Ground Support Equipment Laboratory
Directorate of Research and Development
U. S. Army Missile Command
Redstone Arsenal, Alabama

ABSTRACT

The purpose of this project was to develop one or more protective coatings for the MAULER weapon pod which would protect the exterior surfaces and materials of the pod against the exhaust blasts emitting from MAULER missiles.

This report covers the period of time from 10 July 1964 to 1 July 1965. During this period, 22 materials were evaluated utilizing the actual conditions of MAULER missile firings.

Three materials have demonstrated a satisfactory capability for withstanding MAULER firings. Two of the three materials were subjected to six firing tests while the third material was limited to four firing tests.

The three materials are recommended for use with the MAULER weapon pod and are rated in the order listed below:

1) Two-part epoxy matrix-type coating (RSA 64-4-A specimen)

2) Epoxy and fiberglass, two-part compound coating (RSA 64-6-A specimen)

3) Alkali metal silicate pigmented with inorganic fillers (RSA-64-29-A specimen).

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Continued)

ILLUSTRATIONS (Concluded)

1. Introduction

The previous efforts by the Ground Support Equipment Laboratory on this project are presented in progress reports RL-TM-63-11, dated 9 August 1963, and RL-TM-64-6, dated 21 July 1964. The purpose of this report is to define project activities and results from 10 July 1964 to their completion on 1 July 1965. MAULER firing tests used in this project were completed 14 June 1965.

2. Discussion

a. Purpose of Study

The purpose of this project was to develop a coating material which would provide the best possible protection for the MAULER pod under conditions of multiple firings (Table I). During missile firings, the top surface areas of the MAULER weapon pod are subjected to extremely high temperatures, pressures, and exhaust blast residues emitting from the plumes of MAULER missiles. These environments introduce severe corrosive and erosive conditions which damage the paint finish and basic materials of the weapon pod.

b. New Materials Tested

In addition to 6 specimen materials further investigated from the previous investigation period, there were 16 new specimens tested. The specimen numbers of the 16 materials tested were: RSA 64-17-A, RSA 64-18-A, RSA 64-19-A, RSA 64-20-A, RSA 64-21-A, RSA 64-22-A, RSA 64-23-A, RSA 64-24-A, RSA 64-25, RSA 64-26, RSA 64-27, RSA 64-28-SS, RSA 64-29-A, RSA 64-30-A, RSA 64-31-A, and RSA 64-32-A. The material sources are outlined in Table II.

c. Total Materials Tested This Period

Twenty-two materials were subjected to firing tests at White Sands Missile Range in New Mexico (Table III). The results of the tests are contained in Tables IV and V, and Figures 1 through 58.

d. Materials Obtained During Period (Untested)

Five test specimens were received from the U. S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Maryland. These specimens were received too late to be scheduled for testing. Two of these specimens were damaged in transit between the Aberdeen Proving Ground and the U. S. Army Missile Command at Redstone Arsenal. The data for the five untested specimens are as follows:

Formula	Type
555-111	Fiberglass-Epoxy
555-112	Fiberglass-Epoxy
555-113	Fiberglass-Epoxy-Polyamide
555-121	Fiberglass-Aluminum-Epoxy
555-125	Fiberglass-Urethane

In accordance with verbal instructions from the U. S. Army Coating and Chemical Laboratory, the preceding specimens are to be retained by the Ground Support Equipment Laboratory for possible investigation in future projects.

e. Multiple Firing Test (Two or More)

Finish and coating specimens subjected to multiple firing tests at White Sands Missile Range were as follows:

Specimen No.	No. of Firing Tests
RSA 64-4-A	6*
RSA 64-5-A	2
RSA 64-6-A	6*
RSA 64-7-A	2
RSA 64-14-A	2
RSA 64-21-A	4*
RSA 64-29-A	4*

*Selected for three multiple firing tests which were accomplished on 20 April 1965, 22 April 1965, and 14 June 1965. The four specimens were not weighed, micrometer measured, or photographed until after three firings in succession. RSA 64-4-A, RSA 64-6-A, and RSA 64-29-A performed at an acceptable level, whereas RSA 64-21-A was a failure.

3. Conclusions

a. Pod Protection

The weapon pod firing unit (Figure 59) to be protected includes three areas which receive rocket motor blasts. These areas are as follows (Table VI):

1) Areas that receive nearly perpendicular blasts from the missiles at a relatively close range.

2) Areas that receive less severe non-perpendicular blasts, usually at greater distances from the rocket motor nozzle.

3) Areas that are subjected only to deflected or indirect blast impingement.

b. Methods of Testing

The following were the four basic methods of testing utilized in the overall program:

1) Subjecting specimens to mechanical testing.

2) Subjecting specimens to small 2-inch rocket static firings at the contractor's facilities, or small rocket firings at Redstone Arsenal.

3) Subjecting specimens to MAULER static firings.

4) Subjecting specimens to actual environmental conditions of the MAULER firing unit at White Sands Missile Range in the following order:

a) Promising specimens -- single firing tests.

b) Best promising specimens -- two or three firing tests.

c) Best performing specimens -- multiple firing tests, (4 to 6).

NOTE: Tests performed during the period covered by this report were limited to method 4) above.

c. First Specimens Selection

Specimens subjected to firing tests during period 10 July 1964 to 14 June 1965 were the most promising materials investigated by MICOM. The 22 materials tested during this period were first subjected to a single firing test on the MAULER firing unit before a selection was made of the best performing materials. Those specimens with the highest amount of coating erosion, bonding failures, and other unsatisfactory conditions were disqualified after the first firing test or after subsequent firing tests.

d. Final Specimens Selection

The final selection of specimens for multiple firing tests was made on the basis of coating weight loss, coating percentage loss, condition of coating surface, bonding adherence to substrates, and the availability of remaining firings (Tables VII through XXIX and Figure 60). Some materials showing promise were disqualified in favor of other materials because the testing program from 1 April 1965 to 14 June 1965 limited the number of specimens which could be tested. As a result of an evaluation to determine the best performing materials, four specimens, RSA 64-4-A, RSA 64-6-A, RSA 64-12-A, and RSA 64-29-A, were selected and tested.

e. Specimen Arrangement

Tests conducted at White Sands Missile Range consisted of specimens arranged in clusters of four with the coating substrate panels bolted to test fixtures attached to the firing unit structure (Figures 61 and 62).

f. Conditions

Tests conducted at White Sands Missile Range were confined to one area of the firing unit in order to assure:

1) All materials tested under conditions of the actual firing unit would be subjected to equivalent test conditions.

2) A maximum number of materials could be tested with a minimum number of firings.

g. Acceptable Specimens

Three of the four specimens subjected to successive multiple firing tests, 20 through 22 April 1965 and 14 June 1965, are considered

to have performed on an acceptable level (Table VII). These are RSA 64-4-A, and RSA 64-6-A, which were subjected to a total o. six firings, and RSA 64-29-A, which was subjected to a total of four firings. Specimen RSA 64-21-A was disqualified after subjection to its fourth firing test. All three of the successful specimens are considered to generally meet the prerequisites established for the program. The first two or the successful specimens were materials applied by trowel, whereas the third successful specimen was a material requiring spray application. Specimen RSA 64-4-A was rated above specimen RSA 64-6-A because there were indications of minor bonding failures at two corners of the latter specimen, which were not apparent until after the sixth firing test.

h. Solution

Although three of the candidate materials investigated have shown acceptable results when tested by actual firings, a better solution to the weapon pod deterioration problem would be a factory applied finish and coating capable of withstanding missile blasts for the life of the weapon pod. When future finish and coating developments are made, those materials which have shown promise, but which were disqualified in favor of other more promising materials, should be reinvestigated and subjected to multiple firing tests.

4. Recommendations

a. Field Application

If the MAULER weapon pod is to be protected by finishes and coatings which can be applied and repaired in the field, the following protective finishes and coatings are recommended in order of preference:

1) RSA 64-4-A. Two part epoxy matrix-type coating. Commercial designation: PT-2090 Heat Glaze (see Table XXX for description), Products Techniques Incorporated

2) RSA 64-6-A. Epoxy and fiberglass, two part compound Commercial designation: 7594Y-1 Twin Weld (see Table XXX for description), Schramm Products, Incorporated

3) RSA 64-29-A. Alkali metal silicate pigmented with inorganic fillers. Commercial designation: WSX-5833, Inorganic high temperature coating for missile applications (see Table XXX for description), ENJAY Chemical Company.

b. Further Research

This project should be continued for further evaluation of the three materials recommended above, and the best six of the remaining investigated group, when subjected to a greater number of multiple firings. If additional MAULER firings are not available for continuing the project, other similar test missiles should be used.

A new project should be undertaken to develop factory applied materials, finishes, or both, which are capable of withstanding actual missile blasts for the service life of the MAULER weapon pod. These developments are needed to eliminate field application and repair.

Table I. Coating Prerequisites

General Requirements
1. Coating application should be limited to a maximum three step operation. A single step operation, if feasible, is highly desirable.
2. Coating application should be easy and simple under field conditions with the use of common tools by Army personnel having a minimum of training in application technique. Application of the protective coating by means of either a brush, trowel, or by spray method is desired.
3. The coating material must cure within 16 hours or less after application without the use of supplementary heating equipment. If necessary, drying agents such as amine may be added to the basic compound(s) for expediting curing time. Coating compounds and drying agents must be compatible.
4. The ingredients of the coating material shall be capable of bonding together and adhere strongly to the aluminum surfaces of the weapon pod.
5. Weight of the coating compounds after application and curing shall not exceed 1.5 pounds per square foot. A coating material weighing less than 1.1 pounds per square foot is desired in order to minimize additional weight on the weapon pod.
6. The color of the finished coating compound should match as nearly as possible the color of the weapon pod. Coating compounds, developed locally or obtained from any source, should either be colored olive drab or should be capable of being colored by the addition of non-oily type olive drab pigment.
7. The developed coating when applied shall be capable of withstanding high temperatures of 2000°F to 6000°F, pressures ranging from 100 psi to 400 psi, and the effects of alumina-propellant particles during the blastoff of MAULER missiles for time periods up to 1/8 second. Either a single firing or multiple firings at a stable azimuth and elevation position, or a varied combination of azimuth and elevation positions, are highly probable under tactical situations. Blast impingement points on the weapon pod will vary from 8 to 26 inches under the above stated conditions.

Table I. (Concluded)

8.	The final coating finish should have a nonskid type surface when wet. This type surface is particularly desired for safety of personnel when walking on areas of the weapon pod that are coated with the protective coating material.
9.	The developed coating should be easily repairable as a field fix under tactical conditions, when required, by utilizing identical materials and techniques employed for the initial application of the coating.

Table II. Material Sources and Designators

Specimen	Source
1. RSA 64-4-A (Prepared by GSE Lab)	Product Techniques Incorporated Los Angeles, California (AA)
2. RSA 64-5-A (Prepared by GSE Lab)	Dyna-Therm Chemical Company Burbank, California (BB)
3. RSA 64-6-A (Prepared by GSE Lab)	McMaster-Carr Supply Company Chicago, Illinois (CC)
4. RSA 64-7-A (Prepared by GSE Lab)	Deveon Corporation, Danvers, Massachusetts (DD and Ground Support Equipment Laboratory, Redstone Arsenal, Alabama (EE)
5. RSA 64-14-A RSA 64-15-A (Prepared by C&C Lab)	U. S. Army Coating & Chemical Laboratory, Aberdeen Proving Ground Maryland (FF)
6. RSA 64-17-A RSA 64-18-A RSA 64-19-A RSA 64-20-A (Prepared by Supplier)	Lord Manufacturing Company Erie, Pennsylvania (GG)
7. RSA 64-21-A RSA 64-22-A RSA 64-23-A RSA 64-24-A (Prepared by Supplier)	Raytheon Manufacturing Company Lowell, Massachusetts (HH)
8. RSA 64-25 RSA 64-26 RSA 64-27 (Prepared by GSE Lab)	Raybestos-Manhatten Company Manheim, Pennsylvania (II)
9. RSA 64-28-SS (Prepared by GSE Lab)	National Aeronautics & Space Administration, Redstone Arsenal, Alabama (JJ)
10. RSA 64-29-A RSA 64-30-A (Prepared by Supplier)	ENJAY Chemical Company Division of Humble Oil Co. New Orleans, Louisiana (KK)
11. RSA 64-31-A RSA 64-32-A (Prepared by Supplier)	Thiokol-Alpha Division Redstone Arsenal, Alabama (LL)

Table III. Firing Test Dates for Coating Specimens

Specimen No.	1st Test	2nd Test	3rd Test	4th Test	5th Test	6th Test
RSA 64-4-A	11 Jun 64	22 Jul 64	8 Oct 64	20 Apr 65	22 Apr 65	14 Jun 65
RSA 64-5-A	11 Jun 64	22 Jul 64				
RSA 64-6-A	11 Jun 64	22 Jul 64	8 Oct 64	20 Apr 65	22 Apr 65	14 Jun 65
RSA 64-7-A	11 Jun 64	22 Jul 64				
RSA 64-14-A	25 Jun 64	8 Oct 64				
RSA 64-15-A	25 Jun 64	8 Oct 64				
RSA 64-17-A	11 Dec 64					
RSA 64-18-A	11 Dec 64					
RSA 64-19-A	11 Dec 64					
RSA 64-20-A	11 Dec 64					
RSA 64-21-A	17 Dec 64	20 Apr 65	22 Apr 65	14 Jun 65		
RSA 64-22-A	17 Dec 64					
RSA 64-23-A	17 Dec 64					
RSA 64-24-A	17 Dec 64					
RSA 64-25	13 Jan 65					
RSA 64-26	13 Jan 65					
RSA 64-27	13 Jan 65					
RSA 64-28-SS	13 Jan 65					
RSA 64-29-A	4 Feb 65	20 Apr 65	22 Apr 65	14 Jun 65		
RSA 64-30-A	4 Feb 65					
RSA 64-31-A	4 Feb 65					
RSA 64-32-A	4 Feb 65					

NOTE: Twenty-two materials tested under actual MAULER Firings.

2 subjected to 6 firings
2 subjected to 4 firings
4 subjected to 2 firings
14 subjected to 1 firing

Table IV. Protective Coatings Tested at White Sands Missile Range

Specimen Number	Company Designation	Material Identifier	Method of Application	Coating Average Thickness (in.) (Nominal)	Maximum Removal (% by Wt.)	Approximate Material Makeup	Remarks
RSA 64-4-A	AA	PT-2090	Trowel	3/16	65.35%	Two-part epoxy matrix type coating	Selected for multiple firing tests. Maximum removal after 6 firings.
RSA 64-5-A	BB	E-300	Trowel	3/16	29.37%	Flexible epoxy based compound two-part thixotropic paste	Disqualified due to weight loss and significant coating failures after second firing.
RSA 64-6-A	CC	7594Y41	Trowel	3/16	37.50%	Epoxy and fiberglass two-part compound	Selected for multiple firing tests. Maximum removal after 6 firings. Slight bond separation at 2 corners.
RSA 64-7-A	DD & EE	Epoxy filled ablative compound	Trowel	3/16	29.30%	Epoxy, stainless steel hardener and silicate (approximately 50 mesh)	Disqualified due to weight loss and significant coating failures after second firing.
RSA 64-14-A	FF	CCL 480-1062	Trowel	3/16 to 1/4	23.14%	Flexible type epoxy resin with filler.	Specimen disqualified in favor of other more promising materials having lower weight loss (2nd firing).
RSA 64-15-A	FF	CCL 480-1063	Trowel	3/16 to 1/4	41.50%	Flexible type epoxy resin with filler	Disqualified due to coating separation at lower right corner and upper right side (2nd firing).
RSA 64-17-A	GG	336-1516-(8)	Mold	3/16	2.55%	Silicone elastomeric ablative compound	Disqualified due to bonding failure after first firing.
RSA 64-18-A	GG	336-1949-(9)	Mold	3/16	6.85%	Silicone elastomeric ablative compound	Disqualified due to bonding failure after first firing.
RSA 64-19-A	GG	336-1650-(0)	Mold	3/16	2.31%	Silicone elastomeric ablative compound	Disqualified due to bonding failure after first firing.
RSA 64-20-A	GG	336-1651-(1)	Mold	3/16	7.20%	Silicone elastomeric ablative	Disqualified due to bonding failure after first firing.
RSA 64-21-A	HH	2140	Sprayable	3/16	95.10%	Filled epoxy resin (elastomeric)	Selected for multiple firing tests. Disqualified after fourth firing (Coating disintegrated).

Table IV. (Concluded)

Specimen Number	Company Designation	Material Identifier	Method of Application	Coating Average Thickness (in.) (Nominal)	Maximum Removal (% by Wt.)	Approximate Material Makeup	Remarks
RSA 64-22-A	HH	2145	Sprayable	3/16	6.55%	Filled epoxy resin (medium)	Disqualified in favor of other materials. (Merits further investigation)
RSA 64-23-A	HH	435	Sprayable	3/16	10.18%	Filled epoxy resin (most rigid)	Disqualified due to material chipping and slag condition.
RSA 64-24-A	HH	2138	Trowel	3/16	19.20%	Filled epoxy resin Two-part compound	Disqualified after first firing due to high percentage coating loss.
RSA 64-25	II	RM 45 RPD	Bolted	1/4	0.73%	Composition board slate-asbestos	Disqualified due to brittleness and extensive carbon and burr buildup.
RSA 64-26	II	RM 22 RPD	Bolted	1/4	12/84%	Composition Board	Disqualified after first firing. Specimen approximately 80% destroyed.
RSA 64-27	II	RM 110 RPD	Bolted	1/4	2.45%	Composition Board	Disqualified. Heavy buildup of carbon which scales easily, presenting a hazard.
RSA 64-28-SS	JJ	17-4-PH	Bolted	1/4	0.25%	Stainless Steel	One firing test; tested as a blast shield material.
RSA 64-29-A	KK	WSX-5833	Spray	1/4	23.10%	Alkali metal silicate pigmented with inorganic fillers	Selected for multiple firing tests. Maximum removal after 4 firings.
RSA 64-30-A	KK	LD-3076-M	Spray	1/4	0.00%	Alkali metal silicate pigmented with inorganic fillers.	Disqualified after first firing. Coating separation from substrate (40% area).
RSA 64-31-A	LL	Laboratory Prepared	Trowel	1/4 to 3/8	1.10%	Calcium oxide base carbon and fillers	Specimen disqualified. Separation of coating at left side of substrate.
RSA 64-32-A	LL	Laboratory Prepared	Trowel	1/4	46.45%	Calcium oxide base carbon and fillers	Specimen disqualified. Coating damaged to extent micrometer measurements meaningless.

Table V. Basic Weights and Weight Losses

Specimen	Initial Weight (Grams)			Coating Loss (Grams)						Total Wt. Loss	Total % Loss
	Substrate	Coating	Combined	1st Firing	2nd Firing	3rd Firing	4th Firing	5th Firing	6th Firing		
RSA 64-4-A	422.0	127.0	549.0	24.1	7.5	19.1			32.4	83.0	65.35
RSA 64-5-A	422.0	98.4	520.4	10.5	18.4					28.9	29.37
RSA 64-6-A	422.0	90.8	512.8	5.8	17.0	2.5			9.9	35.2	37.50
RSA 64-7-A	422.0	115.4	537.4	27.9	5.9					33.8	29.30
RSA 64-14-A	422.0	133.7	576.0	12.6	23.44					36.1	23.44
RSA 64-15-A	422.0	100.0	522.0	11.3	30.2					41.5	41.50
RSA 64-17-A	422.0	97.8	519.8	2.5						2.5	2.55
RSA 64-18-A	422.0	86.1	508.1	5.9						5.9	6.80
RSA 64-19-A	422.0	108.0	530.0	2.5						2.5	2.30
RSA 64-20-A	422.0	87.5	509.5	6.3						6.3	7.20
RSA 64-21-A	422.0	110.5	532.5	17.1			88.0			105.1	95.10
RSA 64-22-A	422.0	108.4	530.4	7.1						6.5	6.55
RSA 64-23-A	422.0	113.0	535.0	11.5						11.5	10.18
RSA 64-24-A	422.0	127.6	549.6	24.5						24.5	19.20
RSA 64-25	246.4	0.0	246.4	1.8						1.8	0.73
RSA 64-26	258.6	0.0	258.6	33.2						33.2	12.84
RSA 64-27	273.4	0.0	273.4	6.7						6.7	2.45
RSA 64-28-SS	1132.3	0.0	1132.3	2.8						2.8	0.25
RSA 64-29-A	386.0	47.0	433.0	+1.2 (Gain)			10.9			10.9	23.10
RSA 64-30-A	386.0	49.3	435.3	+2.1 (Gain)						0.0	0.00
RSA 64-31-A	422.0	246.2	668.2	2.7						2.7	1.10
RSA 64-32-A	422.0	155.2	577.2	75.2						75.2	48.45

Table VI. Firing Quadrant Elevation (QE) and Impingement Distance

Firing Number	Firing Designation	Missile QE (Horizontal)	Specimen QE (Vertical)	Impingement Distance
1	STV-9	45.0°	45.0°	12.0"
2	CTV-10	45.0°	45.0°	12.0"
3	RTV-6	30.0°	45.0°	14.0"
4	BTV-10	48.0°	45.0°	14.375"
5	GTV-13	40.5°	45.0°	13.0"
6	BTV-11	52.0°	45.0°	13.0"
7	GTV-14	48.6°	45.0°	13.0"
8	GTV-19	25.0°	45.0°	10.0"
9	GTV-20	23.0°	45.0°	10.0"
10	GTV-22	43.0°	45.0°	11.75"

Table VII. Material Characteristics and Description
(Three Best Performing Specimens Tested)

RSA 64-4-A

100% solids, two component epoxy material. Pigments in the matrix are the type used in fire retardant coatings. Component "A" is white and of 100% solids. Component "B" is of 100% solids heavy grey paste. The components are mixed equal parts by volume; trowel application; pot life three hours: cure time 12 hours or overnight (accelerated curing can be achieved at 180°F for 1 hour by using heat lamps). Weight per gallon - 11 pounds. The cost of this material is approximately $60.58 per 2 gallon kit (discount of 10% on orders in excess of 50 gallons). Available in olive drab color by adding pigment.

RSA 64-6-A

Material is a balanced combination of epoxy resin, hardeners, fillers, etc., regularly specified by NASA in satellite programs. Available in olive drab if specifically ordered in sufficient quantity. Pot life at 25°C ranges 3 to 4 hours. 3/16 inch coating dries in 5 to 6 hours. Two component compounds, "A" and "B" mixed equal parts by volume. Weight per gallon - 10 pounds. Materials can be furnished in 1/10 gallon caulking tubes, 5 gallons of component "A" and 5 gallons of component "B" in a 10 gallon pail. Similarly, a combination of 7 3/4 gallon and 15 1/2 gallon pails could be used with each pail containing 7 1/2 gallons. 55 gallon open head drum. The approximate cost of the material is $31.10 (500 gallons), $30.20 (1000 gallons), $29.15 (1500 gallons), $26.35 (3500 gallons), $25.20 (4500 gallons), $21.80 (5000 gallons). Materials supplied in 55 gallon open head drums, one component to be so pigmented that the color, when the two components are mixed, will be olive drab.

RSA 64-29-A

100% inorganic self-curing, hard-drying, heat resistant protective coating. Two components "A" and "B" required to be premixed prior to use. Available in two one-gallon compartments -- compartment "A" of WSX-5833 is self-curing aqueous alkali metal silicate vehicle, compartment "B" is a specially compounded mixture of powders and dusts imparting solids --LD-3058 special alkali silicate solution 31.7 wt %, other inorganic pigments 20.4 wt %, zinc dust 47.9 wt %. Weight per gallon - 20.13 pounds. Spray gun application. Available in green ceramic pigments (not olive drab). A version of olive drab is available. Drying time -- 5 hours at 75°F (50% R.H.), 2 hours at 90°F (30% R.H.),

Table VII. (Concluded)

15 - 24 hours at 50°F (90% R.H.). Estimated weight (cured state) -- 0.09752 pounds per square foot (4 mils). Cost of materials in quantities of 500, 1000, 1500, 2500, 3500, and 5000 gallon lots (FOB New Orleans, Louisiana) have no firm price. According to supplier, the cost will be approximately $25.00 per gallon.

Table VIII. Detail Weight and Measurement Data RSA 64-4-A

Weight Data (Grams)

Substrate	422.0	Coating	127.0	Weight Loss	Percentage Loss
After Test 1	422.0		102.9	24.1	11.02
After Test 2	422.0		95.4	7.5	13.9
After Test 3	422.0		76.4	19.0	15.04
After Test 6	422.0		44.0	32.4	25.39

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.436	.411	.418	.425	.426	.432	.426	.425	.426	.423	.432	.444	.428
After Firing Test No. 1	.395	.382	.400	.408	.387	.396	.381	.393	.391	.392	.407	.425	.424
Loss	-.041	-.029	-.018	-.017	-.039	-.036	-.045	-.032	-.035	-.031	-.025	-.019	-.004
Tested at White Sands Missile Range 11 June 1964													
Before Firing Test No. 2	.395	.382	.400	.408	.387	.396	.381	.393	.391	.392	.407	.425	.424
After Firing Test No. 2	.414	.384	.393	.390	.376	.385	.377	.385	.377	.397	.391	.401	.421
Loss or Gain	.019	.002	-.007	-.018	-.011	-.011	-.004	-.008	-.014	-.013	-.016	-.024	-.003
Tested at White Sands Missile Range 22 July 1964													
Before Firing Test No. 3	.414	.384	.393	.390	.376	.385	.377	.385	.377	.379	.391	.401	.421
After Firing Test No. 3	.395	.360	.371	.387	.366	.382	.365	.381	.370	.376	.390	.398	.416
Loss	-.019	-.024	-.022	-.003	-.010	-.003	-.012	-.004	-.007	-.003	-.001	-.003	-.005
Tested at White Sands Missile Range 8 October 1964													
Before Firing Tests 4, 5, & 6	.395	.360	.371	.387	.366	.382	.365	.381	.370	.376	.390	.398	.416
After Firing Tests 4, 5, & 6	.332	.287	.296	.329	.305	.337	.309	.334	.321	.316	.327	.332	.351
Loss	-.063	-.073	-.075	-.058	-.061	-.045	-.056	-.047	-.049	-.060	-.063	-.066	-.065
Tested at White Sands Missile Range 20 Apr, 22 Apr, & 14 June 1965													

Remarks: Pitting of material ranged from slight to medium during six firing tests. Appearance of material after six firing tests is superior to all specimens tested. See TABLE VII for material characteristics.

Table IX. Detail Weight and Measurement Data RSA 64-5-A

Weight Data (Grams)

Substrate 422.0	Coating 98.4	Weight Loss	Percentage Loss
After Test 1	87.9	10.4	10.7
After Test 2	69.5	18.4	18.67

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.428	.436	.422	.497	.402	.418	.428	.410	.406	.406	.412	.410	.425
After Firing Test No. 1	.405	.414	.399	.393	.40[illegible]	.390	.393	.413	.397	.429	.397	.386	.408
Loss or Gain	-.026	-.022	-.023	-.014	.000	-.028	-.035	.003	-.009	.023	-.015	-.024	-.017
Tested at White Sands Missile Range 11 June 1964													
Before Firing Test No. 2	.403	.414	.399	.393	.402	.390	.393	.413	.397	.429	.397	.386	.408
After Firing Test No. 2	.386	.395	.398	.369	.387	.360	.375	.393	.375	.404	.260	.362	.388
Loss	-.017	-.019	-.001	-.024	-.015	-.030	-.018	-.020	-.022	-.025	-.137	-.024	-.020
Tested at White Sands Missile Range 22 July 1964													

Remarks: Coating material severely damaged at center right portion of specimen; deep pitting approximately 3/16 inch diameter by 1/8 inch depth occurred at three separate areas of the specimen. Coating material specimen disqualified.

Table X. Detail Weight and Measurement Data RSA 64-6-A

Weight Data (Grams)			
Substrate 422.0	Coating 90.8	Weight Loss	Percentage Loss
After Test 1 422.0	85.0	5.8	6.39
After Test 2 422.0	68.0	17.0	18.7
After Test 3 422.0	65.5	2.5	0.27
After Test 6 422.0	55.6	9.9	12.14

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.403	.423	.411	.411	.401	.411	.402	.387	.432	.400	.409	.384	.397
After Firing Test No. 1	.418	.414	.410	.395	.398	.404	.422	.412	.404	.408	.427	.416	.414
Loss or Gain	.015	-.009	-.001	-.016	-.003	-.007	.020	.025	-.028	.008	.018	.032	.017
Tested at White Sands Missile Range 11 June 1964													
Before Firing Test No. 2	.418	.414	.410	.395	.398	.404	.422	.412	.404	.408	.427	.416	.414
After Firing Test No. 2	.397	.396	.396	.388	.388	.397	.418	.407	.402	.401	.428	.405	.410
Loss or Gain	-.021	-.018	-.014	-.007	-.010	-.007	-.004	-.005	-.002	-.007	.001	-.011	-.004
Tested At White Sands Missile Range 22 July 1964													
Before Firing Test No. 3	.397	.396	.396	.388	.388	.397	.418	.407	.402	.401	.428	.405	.410
After Firing Test No. 3	.397	.381	.387	.382	.379	.396	.415	.404	.402	.401	.423	.404	.410
Loss	.000	-.015	-.009	-.006	-.009	-.001	-.003	-.003	.000	.000	-.005	-.001	.000
Tested at White Sands Missile Range 8 October 1964													
Before Firing Tests 4, 5, & 6	.397	.381	.387	.382	.379	.396	.415	.404	.402	.401	.423	.404	.410
After Firing Tests 4, 5, & 6	.329	.307	.376	.321	.324	.334	.355	.349	.353	.358	.391	.390	.377
Loss	-.068	-.074	-.011	-.061	-.055	-.062	-.060	-.055	-.049	-.043	-.032	-.014	-.033
Tested at White Sands Missile Range 20 Apr, 22 Apr, and 14 June 1965													

Remarks: Specimen material remained semi-flexible throughout six firing tests. Bonding failure at upper left and lower right corner observed after sixth firing test. Appearance of specimen material is considered to be acceptable and is rated as the second best performing material tested. See TABLE VII for material characteristics.

Table XI. Detail Weight and Measurement Data RSA 64-7-A

Substrate 422.5	Coating 115.4	Weight Loss	Percentage Loss
After Test 1 422.0	87.5	27.9	24.2
After Test 2 422.0	81.6	5.9	5.1

Weight Data (Grams)

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.405	.398	.386	.398	.394	.398	.405	.373	.412	.380	.438	.429	.394
After Firing Test No. 1	.364	.359	.361	.369	.368	.359	.367	.361	.354	.378	.393	.403	.409
Loss or Gain	-.041	-.039	-.025	-.029	-.026	-.039	-.038	-.012	-.058	-.002	-.045	-.026	.015
Tested at White Sands Missile Range 11 June 1964													
Before Firing Test No. 2	.364	.359	.361	.369	.368	.359	.367	.361	.354	.378	.393	.403	.409
After Firing Test No. 2	.347	.327	.279	.343	.338	.340	.336	.333	.324	.344	.372	.374	.379
Loss	-.017	-.032	-.082	-.026	-.030	-.019	-.031	-.028	-.030	-.034	-.021	-.029	-.030
Tested at White Sands Missile Range 22 July 1964													

Remarks: Material separated from substrate the full length of the left side (varying in width 1/4 inch to 1/2 inch); at upper edge, and at right center edge. Weight loss and material failures significantly warranted disqualification. Specimen disqualified after second firing test.

Table XII. Detail Weight and Measurement Data RSA 64-14-A

Weight Data (Grams)

Substrate 422.0			Coating 154.0			Weight Loss				Percentage Loss			
After Test 1 422.0			141.4			12.6				7.5			
After Test 2 422.0			117.9			23.5				15.94			
	Specimen Stations												
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.399	.440	.346	.460	.438	.450	.458	.409	.434	.432	.406	.436	.423
After Firing Test No. 1	.385	.421	.355	.444	.429	.438	.450	.404	.432	.430	.406	.434	.363
Loss or Gain	-.014	-.019	-.009	-.016	-.009	-.012	-.008	-.005	-.002	-.002	.000	-.002	-.060
Tested at White Sands Missile Range 25 June 1964													
Before Firing Test No. 2	.385	.421	.355	.444	.429	.438	.450	.404	.432	.430	.406	.434	.363
After Firing Test No. 2	.313	.383	.306	.416	.404	.424	.425	.404	.411	.408	.405	.411	.343
Loss or Gain	-.072	-.038	- 049	-.028	-.025	-.014	-.025	.000	-.021	-.022	-.001	-.023	-.020
Tested at White Sands Missile Range 8 October 1964													

Remarks: Minor to slight erosion at top left center of specimen; slight to medium erosion at both lower corners of substrate in area of washers. Station No. 1 reveals a total loss of .072 inch after second firing test. Specimen disqualified in favor of two other materials (RSA 64-21-A nd RSA 64-29-A) which pe formed exceptionally well during first firing test.

Table XIII. Detail Weight and Measurement Data RSA 64-15-A

Weight Data (Grams)

Substrate 422.0	Coating 100.0	Weight Loss	Percentage Loss
After Test 1 422.0	88.7	11.3	10.3
After Test 2 422.0	58.5	30.2	31.2

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.368	.387	.368	.402	.395	.400	.400	.385	.396	.390	.357	.383	.350
After Firing Test No. 1	.360	.374	.351	.394	.381	.394	.396	.373	.393	.386	.359	.381	.352
Loss or Gain	-.008	-.013	-.017	-.008	-.014	-.006	-.004	-.012	-.003	-.004	.002	-.002	.002
	Tested at White Sands Missile Range 25 June 1964												
Before Firing Test No. 2	.360	.374	.351	.394	.381	.394	.396	.373	.393	.386	.359	.381	.352
After Firing Test No. 2	.322	.327	.281	.361	.350	.364	.363	.334	.371	.352	.346	.358	.324
Loss	-.038	-.047	-.070	-.033	-.031	-.030	-.033	-.039	-.022	-.034	-.013	-.023	-.028
	Tested at White Sands Missile Range 8 October 1964												

Remarks: Severe scaling and separation of coating from substrate in lower right corner and upper right side. Specimen disqualified due to pronounced separations.

Table XIV. Detail Weight and Measurement Data RSA 64-17-A

Weight Data (Grams)				
Substrate 422.0	Coating 97.8	Weight Loss	Percentage Loss	
After Test 1 422.0	95.3	2.5	2.55	

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.413	.418	.417	.412	.416	.413	.414	.415	.415	.413	.418	.415	.420
After Firing Test No. 1	.415	.416	.415	.409	.412	.413	.416	.414	.410	.408	.419	.403	.411
Loss or Gain	.002	-.002	-.002	-.003	-.004	.000	.002	-.001	-.005	-.005	.001	-.012	-.009

Tested at White Sands Missile Range 11 December 1964

Remarks: Minor washup at stations 1, 7, and 11. Bonding separation of coating from substrate occurred at both lower corners of the specimen. The specimen was disqualified for bonding failure; however, the material performed exceptionally well and should be investigated for similar application, if feasible.

Table XV. Detail Weight and Measurement Data RSA 64-18-A

Weight Data (Grams)

Substrate 422.0	Coating 86.1	Weight Loss	Percentage Loss
After Test 1 422.0	80.2	5.9	6.8

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.425	.423	.425	.421	.424	.423	.425	.429	.420	.422	.427	.422	.425
After Firing Test No. 1	.421	.417	.420	.412	.415	.419	.414	.414	.415	.412	.415	.414	.420
Loss	-.004	-.006	-.005	-.009	-.009	-.004	-.011	-.015	-.005	-.008	-.012	-.008	-.005

Tested at White Sands Missile Range 11 December 1964

Remarks: Bonding separation of coating occurred between the material and substrate at upper left corner and lower left corner. The specimen was disqualified for bonding failure; however, the material performed exceptionally well and should be investigated for similar application, if feasible.

Table XVI. Detail Weight and Measurement Data RSA 64-19-A

Weight Data (Grams)

Substrate 422.0 After Test 1 422.0	Coating 108.0 105.5						Weight Loss 2.5			Percentage Loss 2.3		
	Specimen Stations											
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.428	.427	.428	.423	.425	.430	.433	.430	.430	.426	.430	.427	.428
After Firing Test No. 1	.424	.427	.421	.423	.424	.422	.425	.426	.416	.422	.431	.415	.419
Loss or Gain	-.004	.000	-.007	.000	-.001	-.008	-.008	-.004	-.003	-.004	.001	-.012	-.009
	Tested at White Sands Missile Range 11 December 1964												

Remarks: Negligible washup occurred at station No. 11. Bonding separation of coating from substrate occurred at upper right corner and lower right corner of specimen. Specimen disqualified because of bonding failure; however, the material performed exceptionally well and should be investigated for similar application, if feasible.

Table XVII. Detail Weight and Measurement Data RSA 64-20-A

Weight Data (Grams

Substrate 422.1	Coating 87.5	Weight Loss	Percentage Loss
After Test 1	81.2	6.3	7.2

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.424	.423	.433	.419	.423	.425	.421	.425	.425	.423	.430	.426	.431
After Firing Test No. 1	.417	.416	.418	.411	.410	.414	.414	.414	.412	.417	.420	.419	.419
Loss	-.007	-.007	-.015	-.008	-.013	-.011	-.007	-.011	-.013	-.006	-.010	-.007	-.012

Tested at White Sands Missile Range 11 December 1964

Remarks: Bonding separation occurred between coating and substrate at lower right corner of specimen. The specimen was disqualified because of bonding failure; however, the material performed exceptionally well and should be investigated for similar application, if feasible.

Table XVIII. Detail Weight and Measurement Data RSA 64-21-A

Weight Data (Grams)

Substrate 422.0	Coating 110.5	Weight Loss	Percentage Loss
After Test 1 422.0	93.4	17.1	15.5
After Test 4 422.0	5.4	88.0	60

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.437	.448	.438	.438	.443	.437	.445	.423	.439	.446	.430	.433	.434
After Firing Test No. 1	.425	.432	.436	.426	.433	.418	.444	.448	.437	.440	.422	.425	.442
Loss or Gain	-.012	-.016	-.002	-.012	-.010	-.019	-.001	.025	-.002	-.006	.008	-.008	008
	Tested at White Sands Missile Range 17 December 1964												
Before Firing Test No. 2, 3, &4	.425	.432	.436	.426	.433	.418	.444	.448	.437	.440	.422	.425	.442
After Firing Test No. 2, 3, &4	.388	-0-	.352	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Loss	-.037	-.432	-.084	-.426	-.433	-.418	-.444	-.448	-.437	-.440	-.442	-.425	-.442
	Tested at White Sands Missile Range 20 April, 22 April, and 14 June 1965												

Remarks: Negligible pitting present on entire surface of coating Pitting is uniform with no indication of severe failure after subjection to first firing test. Specimen subjected to three additional firing tests and the material disintegrated during these tests to the extent that there was a 95.19 percent loss of coating from the substrate. Specimen disqualified after firing test number four.

Table XIX. Detail Weight and Measurement Data RSA 64-22-A

Weight Data (Grams)

Substrate 422.0	Coating 108.4	Weight Loss	Percentage Loss
After Test 1	101.3	7.1	6.55

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.453	.458	.452	.464	.4[illegible]	.455	.470	.466	.462	.466	.446	.458	.473
After Firing Test No. 1	.431	.440	.441	.436	.454	.422	.452	.445	.431	.445	.452	.444	.444
Loss or Gain	-.022	-.018	-.011	-.028	.011	-.033	-.018	-.021	-.031	-.021	.014	-.014	-.029

Tested at White Sands Missile Range 17 December 1964

Remarks: Washup occurred at station 11. Negligible pitting present on entire surface of coating. Pitting was not uniform and there was an indication of slight cracks, erosion, and carbon buildup. Specimen was disqualified in favor of other materials. The material has merit and should be considered for investigation for use in applications similar to this project.

Table X. Detail Weight and Measurement Data - RSA 64-23-A

Weight Data (Grams)

Substrate 432.9 After Test 1	Coating 113.0 101.5				Weight Loss 11.5				Percentage Loss 10.18			
	Specimen Sections											
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.465	.464	.474	.447	.440	.456	.439	.462	.446	.440	.452	.443	.454
After Firing Test No. 1	.451	.449	.459	.422	.420	.433	.393	.429	.405	.400	.446	.406	.356
Loss	-.014	-.015	-.015	-.025	-.020	-.023	-.046	-.033	-.041	-.040	-.006	-.037	-.098

Tested at White Sands Missile Range 17 December 1954

Remarks: Coating chipped at center left side and at lower left and right corners. Excessive slag crust deposited on specimen coating. This condition would not be desirable under tactical conditions. Specimen disqualified because of chipping and slag condition.

Table XXI. Detail Weight and Measurement Data RSA 64-24-A

Weight Data (Grams)

Substrate	422.0	Coating	127.0	Weight Loss	Percentage Loss
After Test 1		103.5		24.5	19.20

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.450	.437	.449	.409	.434	.435	.433	.452	.421	.440	.446	.452	.461
After Firing Test No. 1	.420	.413	.442	.402	.390	.423	.406	.422	.413	.407	.438	.435	.445
Loss	-.030	-.024	-.007	-.007	-.044	-.012	-.027	-.030	-.008	-.033	-.008	-.017	-.016

Tested at White Sands Missile Range 17 December 1964

Remarks: Specimen lost 19.20 percent of coating upon initial firing test. Specimen disqualified due to the high percentage of coating loss.

Table XXII. Detail Weight and Measurement Data RSA 65-25

Weight Data (Grams)

Substrate 246.4	Coating -0- N/A	Weight Loss	Percentage Loss
After Test 1 244.6	-0- N/A	1.8	0.73

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.252	.251	.252	.251	.252	.253	.252	.252	.251	.251	.253	252	.252
After Firing Tert No. 1	.268	.253	.252	.256	.262	.264	.265	.264	.261	.264	.256	.260	.261
Gain	.016	.002	.000	.005	.010	.011	.010	.012	.010	.007	.013	.008	.009

Tested at White Sands Missile Range 13 January 1965

Remarks: Buildup of material ranged from .001 inch to 0.16 maximum. Extensive carbon and burr buildup on approximately 3/3 of specimen surface. Material is excessively brittle. Brittleness appears to have resulted from heat emitting during missile blast. Specimen disqualified due to brittleness.

Table XXIII. Detail Weight and Measurement Data RSA 64-26

Weight Data (Grams)

Substrate 258.5 After Test 1 235.4	Coating -0- N/A -0- N/A						Weight Loss 33.?				Percentage Loss 12.84		
	Specimen Stations												
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.300	.291	.299	.297	.292	.299	.295	.291	.298	.295	.303	.298	.295
After Firing Test No. 1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Loss	Specimen damaged to the extent that measurements would be meaningless.												
	Tested at White Sands Missile Range 13 January 1965												

Remarks: Specimen approximately 80 percent destroyed during first firing test. Specimen disqualified due to destruction.

Table XXIV. Detail Weight and Measurement Data - RSA 64-27

Weight Data (Grams)

Substrate 273.4 After Test : 266.7	Coating -0- N/A -0- N/A				Weight Loss 6.7				Percentage Loss 2.45				
	Specimen Stations												
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.251	.254	.261	.255	.258	.244	.255	.258	.249	.254	.236	.252	.257
After Firing Test No. 1	.251	.259	.265	.262	.271	.254	.272	.280	.264	.271	.247	.257	.272
Gain	.000	.005	.004	.007	.013	.010	.017	.022	.015	.017	.011	.005	.015
Tested at White Sands Missile Range 13 January 1965													

Remarks: Specimen supports heavy buildup of carbon deposit. Carbon scales easily, thereby providing a potential safety hazard to personnel footing. The specimen was disqualified due to carbon and scaling condition.

Table XXV. Detail Weight and Measurement Data - RSA 64-28-SS

Weight Data (Grams)

Substrate 1122.2	Coating -0- N/A	Weight Loss	Percentage Loss
After Test 1 1129.5	-0- H/A	2.8	0.25

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.257	.258	.259	.257	.257	.255	.254	.254	.257	.254	.257	.256	.254
After Firing Test No. 1	.263	.268	.288	.275	.277	.272	.268	.275	.271	.268	.263	.271	.281
Gain	.006	.010	.029	.018	.020	.017	.014	.021	.014	.014	.006	.015	.027

Tested at White Sands Missile Range 13 January 1965

Remarks: Extensive carbon buildup on surface of specimen. Carbon deposit scales easily, providing a potential safety hazard to personnel footing. Carbon separates easily from stainless steel surface at each corner and erosion observed at those areas. Calculated weight of stainless steel reveals a serious weight problem. Specimen disqualified for excessive weight and cost.

Table XXVI. Detail Weight and Measurement Data - RSA 64-29-A

Weight Data (Grams)

Substrate 386.0	Coating 47.0	Weight Loss	Percentage Loss
After Test 1 386.0	48.2	(Gain 1.2)	0.0
After Test 4 386.0	36.1	10.9	23.1

Measurement	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.273	.274	.273	.274	.275	.277	.275	.274	.274	.275	.275	.275	.275
After Firing Test No. 1	.274	.277	.274	.278	.282	.276	.282	.277	.281	.279	.279	.284	.281
Loss or Gain	.001	.003	.001	.004	.007	-.001	.007	.003	.007	.004	.004	.009	.006
	Tested at White Sands Missile Range 4 February 1965												
Before Firing Test No. 2, 3, &4	.274	.277	.274	.278	.282	.276	.282	.277	.281	.279	.279	.284	.281
After Firing Test No. 2, 3, &4	.235	.254	.200	.241	.213	.241	.222	.238	.224	.216	.227	.236	.256
Loss	-.039	-.023	-.074	-.037	-.069	-.035	-.060	-.039	-.057	-.063	-.052	-.053	-.025
	Tested at White Sands Missile Range 20 April, 22 April, and 14 June 1965												

Remarks: Minor buildup of carbon and spiked burrs prevelant on face of coating, resulting in an increased thickness of coating (negligible). After the first firing test there was no visible indication of any appreciable damage. Appearance of material after four firing tests is considered to be acceptable and is rated as third best performing material tested. See Table VII for material characteristics.

Table XXVII. Detail Weight and Measurement Data - RSA 64-30-A

Weight Data (Grams)

Substrate 422.0	Coating 13.3	Weight Loss	Percentage Loss
After Test 1 422.0	15.4	2.1 gain	0.0

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.272	.274	.272	.273	.274	.273	.274	.272	.275	.276	.273	.275	.272
After Firing Test No. 1	.274	.278	.274	.279	.279	.284	.295	.289	.282	.284	.274	.283	.275
Gain	.002	.004	.002	.006	.005	.011	.021	.017	.007	.008	.001	.003	.003

Tested at White Sands Missile Range 4 February 1965

Remarks: Complete separation of coating in upper 40 percent of specimen. Heat exhaust from missile resulted in substrate's being damaged at the left side of the specimen in area where coating separated. Specimen disqualified due to coating separation.

Table XXVIII. Detail Weight and Measurement Data - RSA 64-31-A

Weight Data (Grams)

Substrate 472.0	Coating 346.2	Weight Loss	Percentage Loss
After Test 1 469.3	343.5	2.7	1.1

	Specimen Stations												
Measurements	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.568	.526	.523	.393	.544	.559	.554	.556	.543	.549	.560	.513	.529
After Firing Test No. 1	.560	.554	.561	.538	.567	.511	.555	.518	.542	.537	.562	.512	.526
Loss or Gain	-.008	.028	.038	-.055	.023	-.048	+.001	-.038	-.001	-.012	.002	-.001	-.003
	Tested at White Sands Missile Range 4 February 1965												

Remarks: Coating chipped adjacent to upper right and lower left test fixture mounting holes. Minor flaking of coating material at top upper one third area of specimen. Bonding failure between coating and substrate at left side of specimen. Specimen disqualified due to bonding failure and chipping of material.

Table XXIX. Detail Weight and Measurement Data - RSA 64-32-A

Weight Data (Grams)

Substrate 422.0	Coating 155.2	Weight Loss	Percentage Loss
After Test 1 422.0	80.0	75.2	48.45

Measurements	Specimen Stations												
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Before Firing Test No. 1	.512	.498	.496	.477	.484	.466	.474	.502	.479	.506	.501	.500	.543
After Firing Test No. 1	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Loss or Gain	Specimen damaged to the extent that measurement would be meaningless												

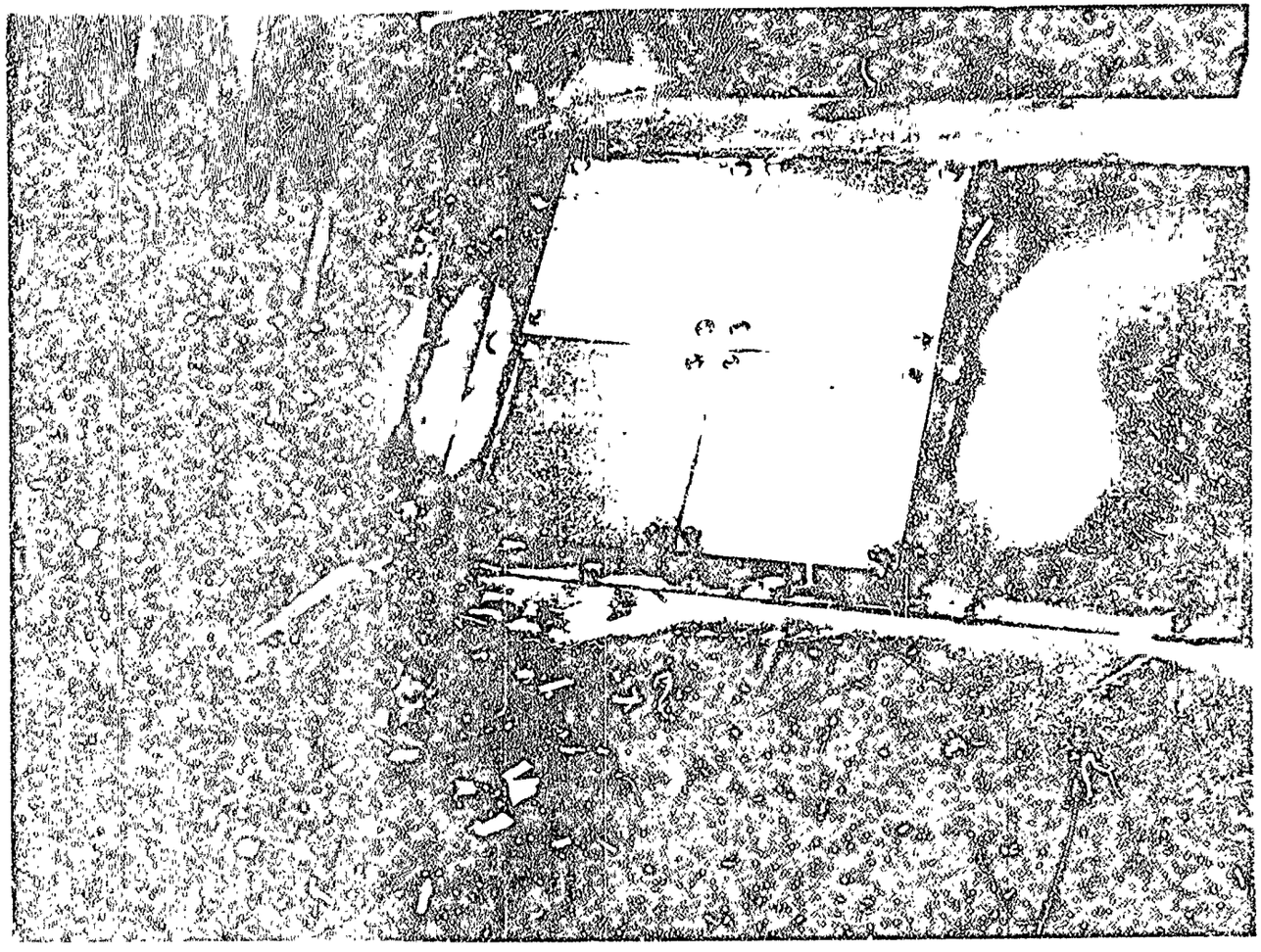
Tested at White Sands Missile Range 4 February 1965

Remarks: Approximately 45 percent of the coating separated from the substrate at the left side of the specimen, and the right side of the specimen. Coating remaining on substrate is porous. Specimen damaged to the extent that micrometer measurements would be meaningless. The specimen was disqualified due to material separation.

Table XXX. Application Weight Data

Specimen Number	Grams Per Specimen	Grams Sq/Ft Equivalent	Grams 80 Sq Ft	Pounds Required 80 Sq Ft
RSA 64-4-A	127.0	254.0	20,320	46.62*
PSA 64-5-A	98.4	196.8	15,744	34.69
RSA 64-6-A	90.8	181.6	14,528	32.00*
RSA 64-7-A	115.4	230.8	18,464	40.68
RSA 64-14-A	133.7	267.4	21,392	47.13
RSA 64-15-A	100.0	200.0	16,000	35.25
RSA 64-17-A	97.8	195.6	15,648	34.47
RSA 64-18-A	86.1	172.2	13,776	30.35
RSA 64-19-A	108.0	216.0	17,280	38.07
RSA 64-20-A	87.5	175.0	14,000	30.85
RSA 64-21-A	110.5	221.0	17,680	38.95
RSA 64-22-A	108.4	216.8	17,344	38.21
RSA 64-23-A	113.0	226.0	18,080	39.83
RSA 64-24-A	127.6	255.2	20,416	44.98
RSA 64-25	246.4	492.8	39,424	86.86
RSA 64-26	258.6	517.2	41,376	91.16
RSA 64-27	273.4	546.8	43,944	96.81
RSA 64-28-SS	1132.2	2264.4	181,152	399.10
RSA 64-29-A	47.0	94.0	7,520	16.5.*
RSA 64-30-A	49.3	98.6	7,88[illegible]	17.38
RSA 64-31-A	296.2	592.4	47,392	104.41
RSA 64-32-A	155.2	210.4	16,832	37.08

*Recommended material based upon results of multiple firing tests



Installation of Coating Specimens on MAULER
Weapon Pod for Test

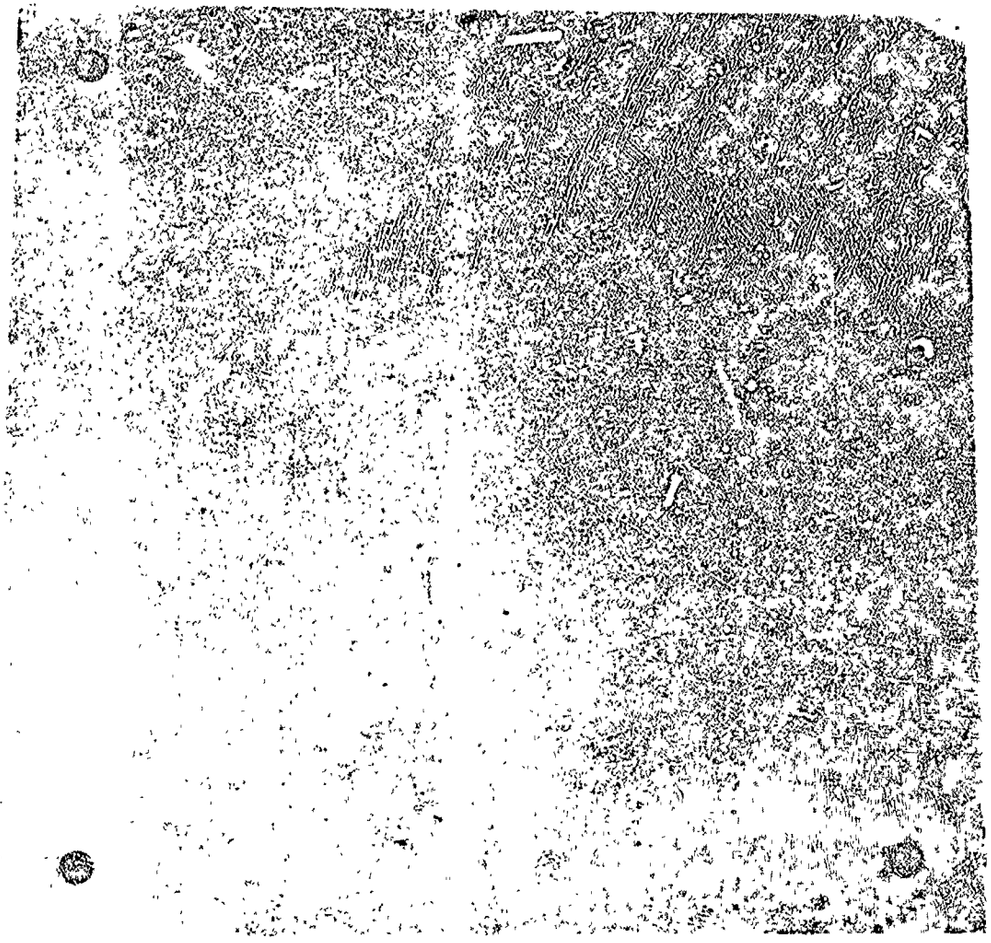


Figure 2. Coating Specimen RSA 64-4-A Before Test No. 1

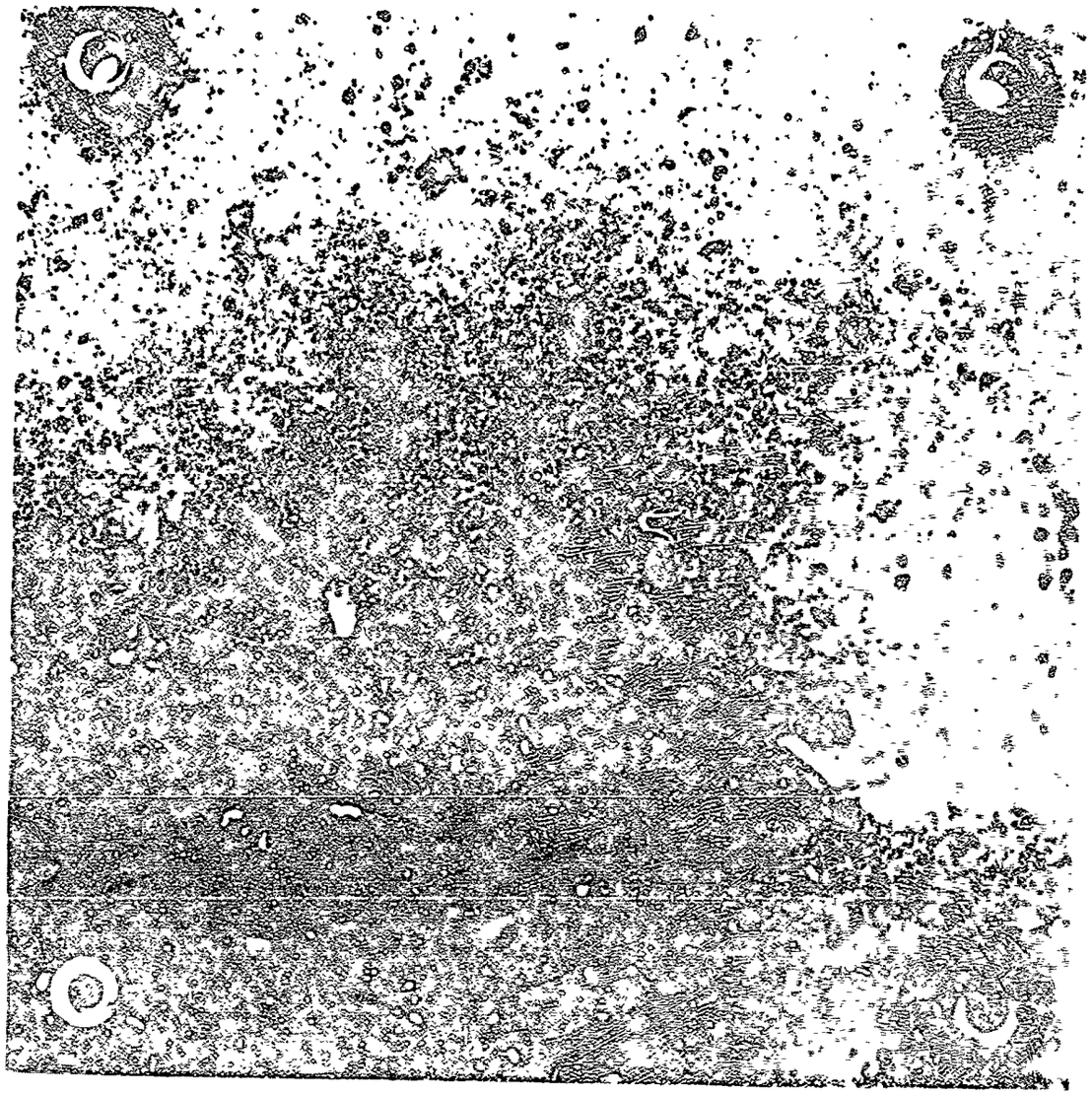


Figure 3. Coating Specimen RSA 64-4-A After Test No. 1

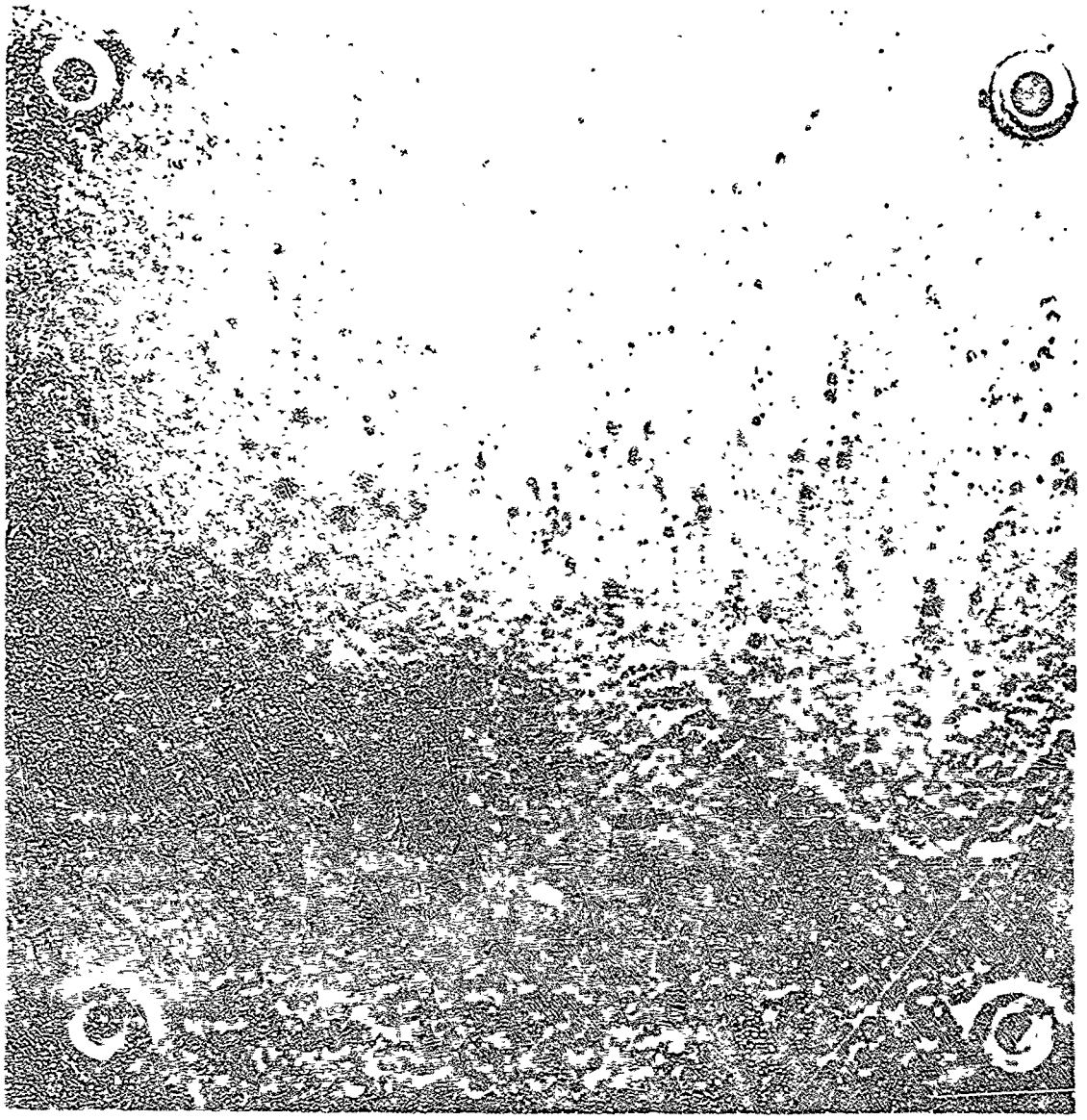


Figure 4. Coating Specimen RSA 64-4-A After Test No. 2

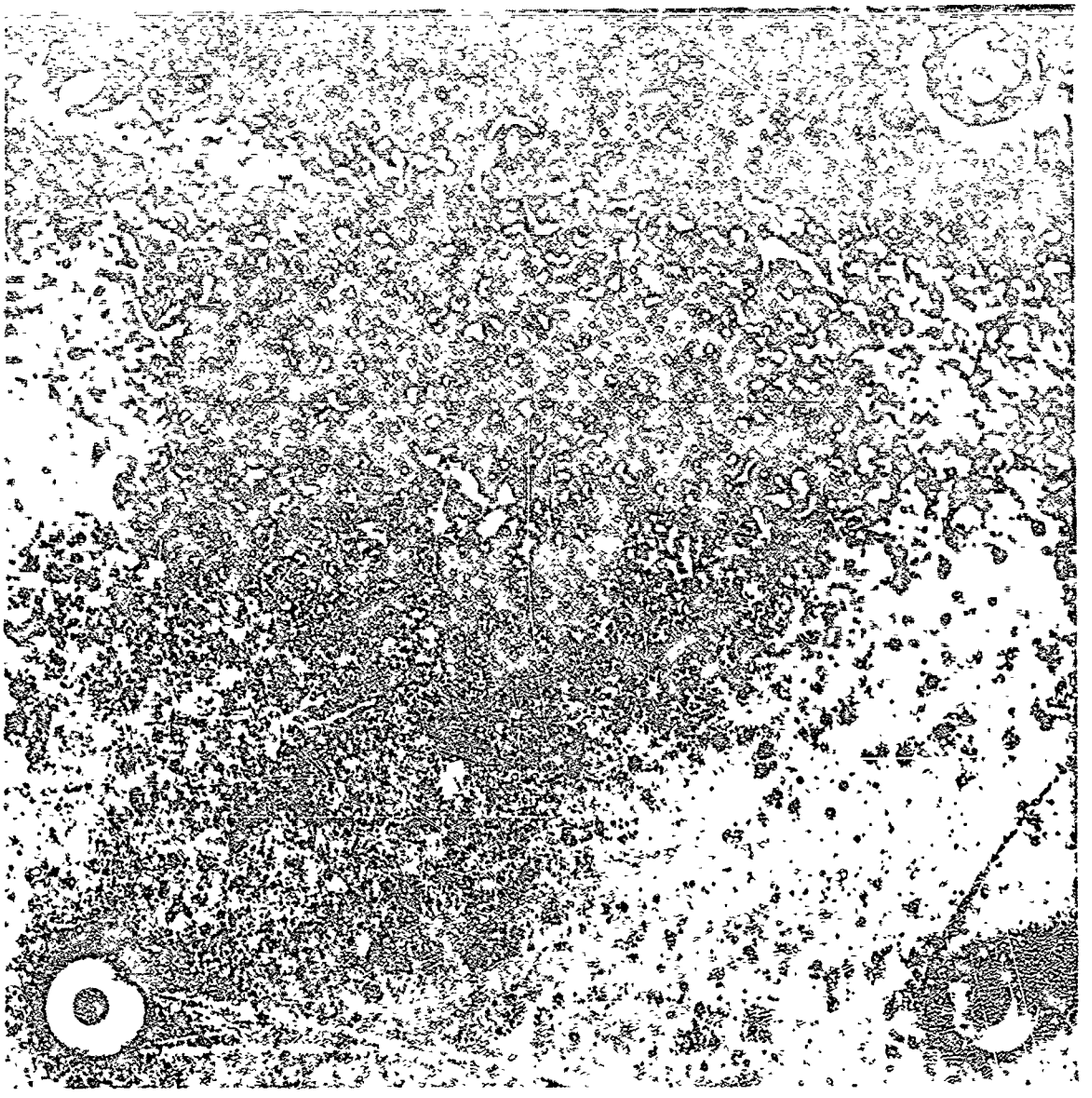


Figure 5. Coating Specimen RSA 64-6-A After Test No. 3

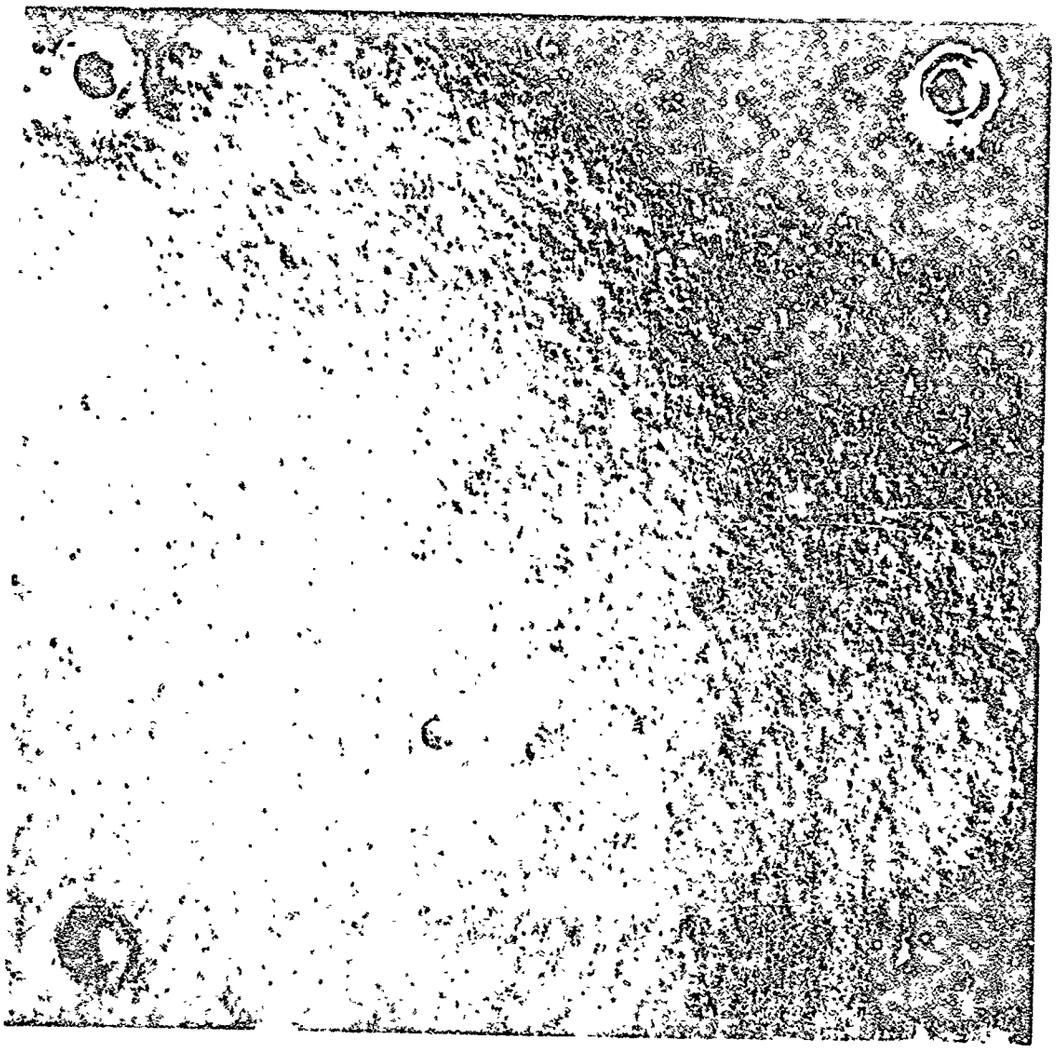


Figure 6. Coating Specimen RSA 64-4-A After Multiple Firing Test Nos. 4, 5, and 6

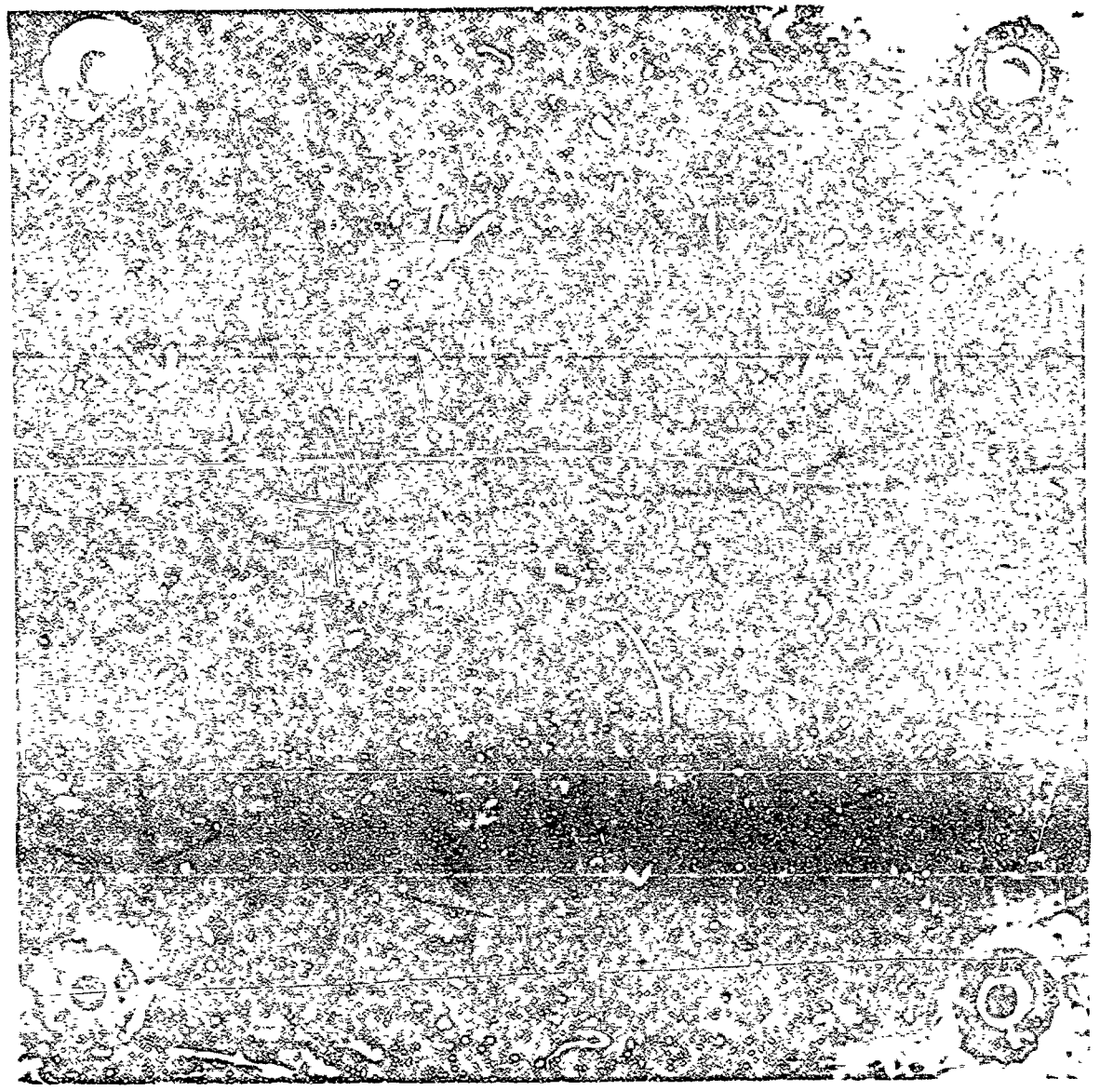
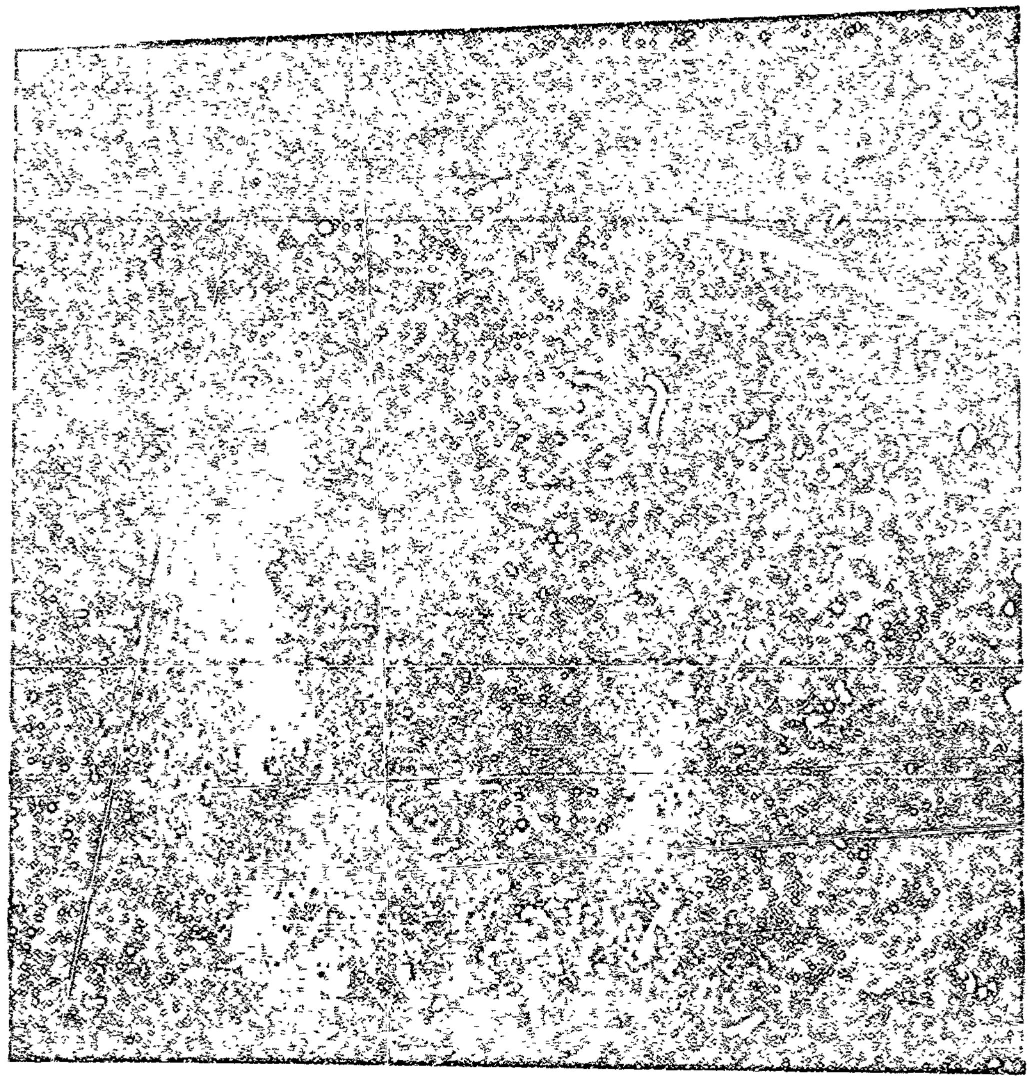


Figure 7. Coating Specimen RSA 64-5-A Before Test No. 1



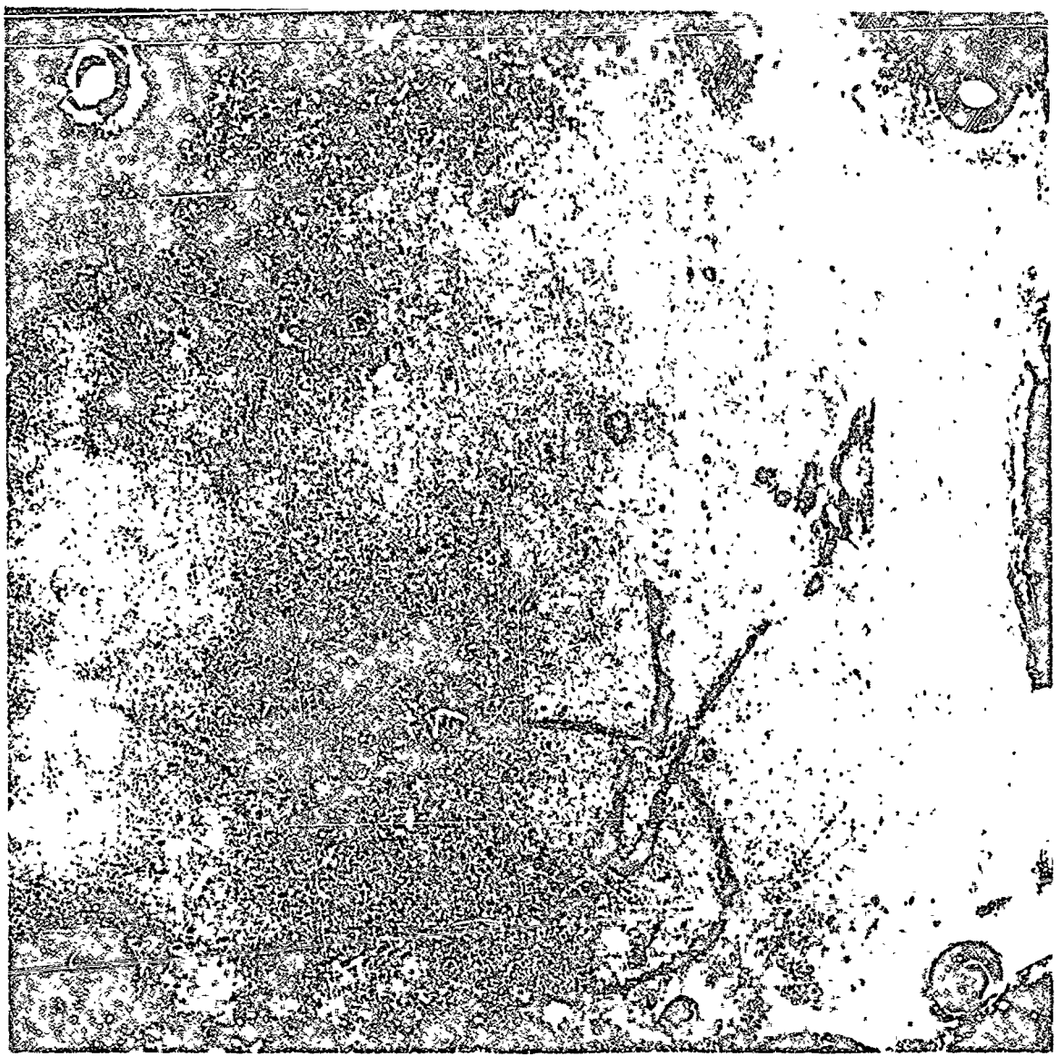


Figure 9. Coating Specimen RCA 64-5-A After Test No. 2

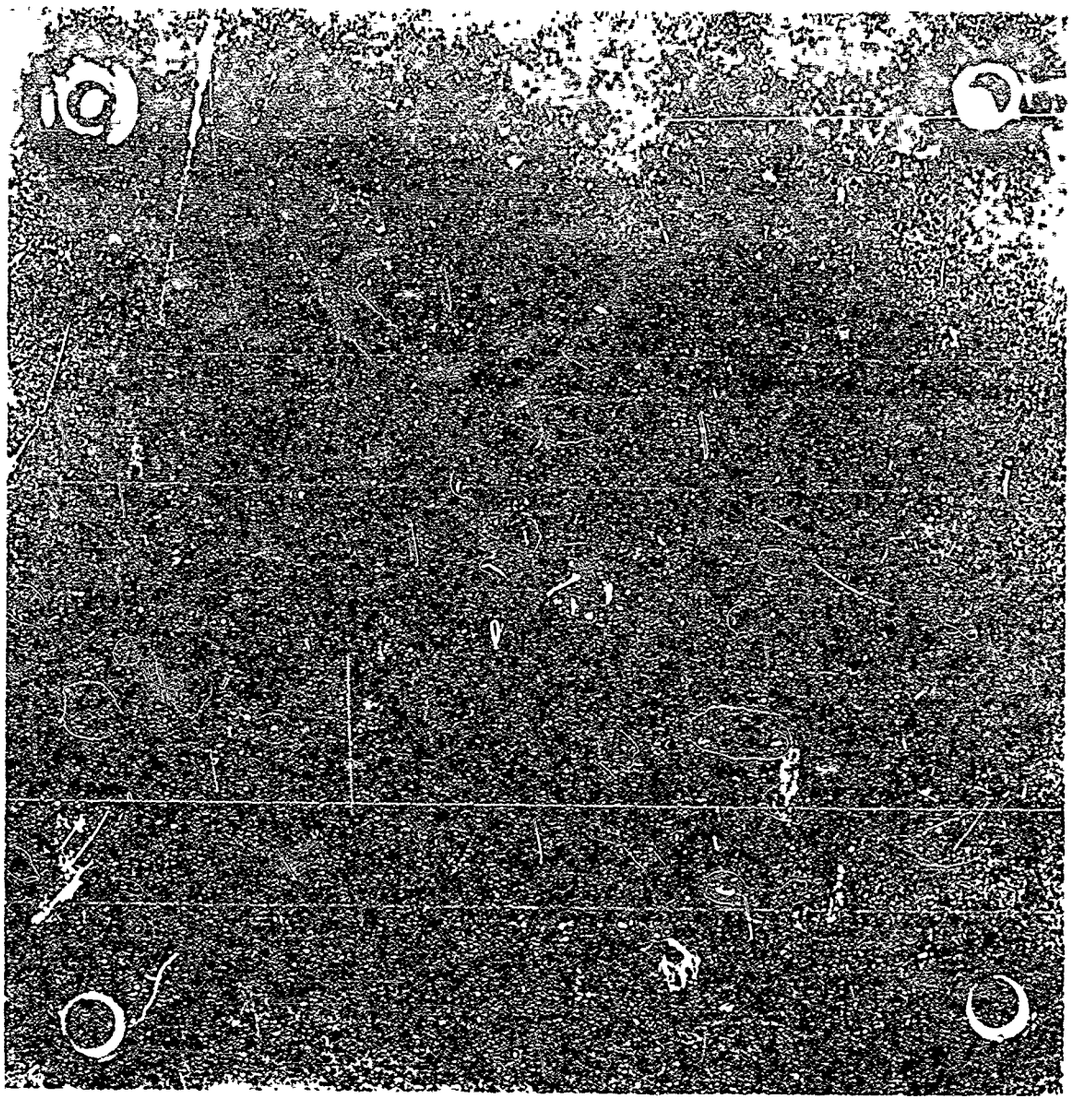


Figure 11. Coating Specimen RSA 64-6-A After Test No. 1

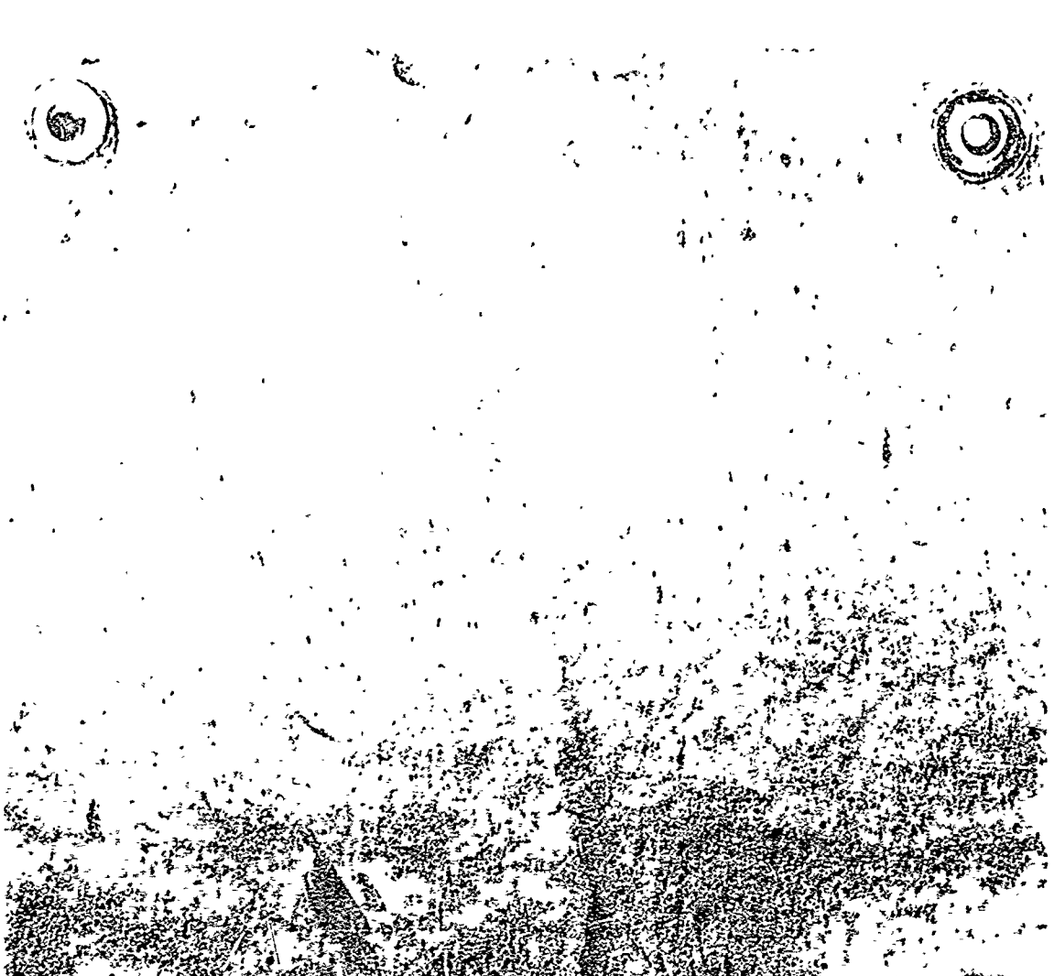


Figure 12. Coating Specimen RSA 64-6-A After Test No. 2

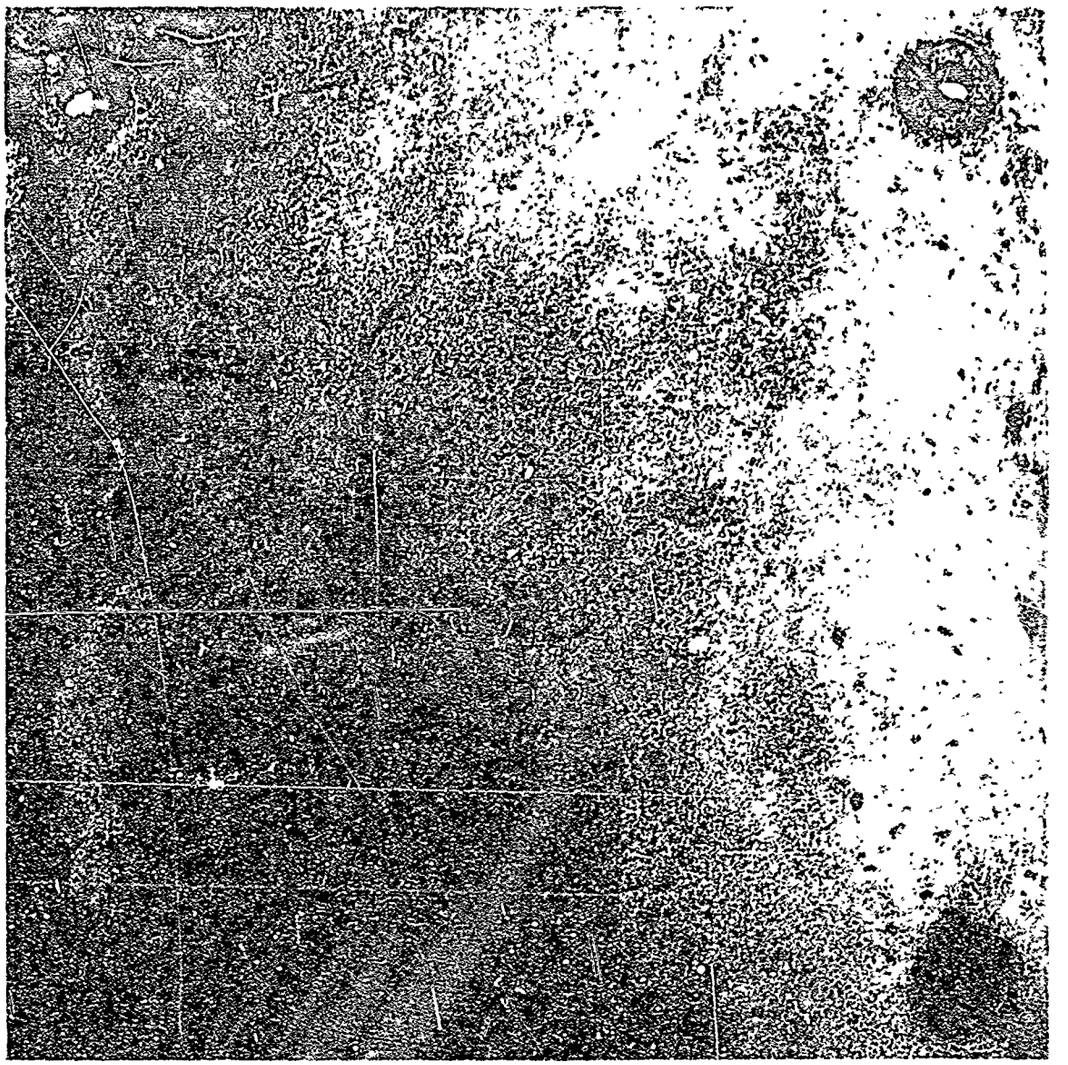


Figure 13. Coating Specimen RSA 64-6-A After Test No. 3

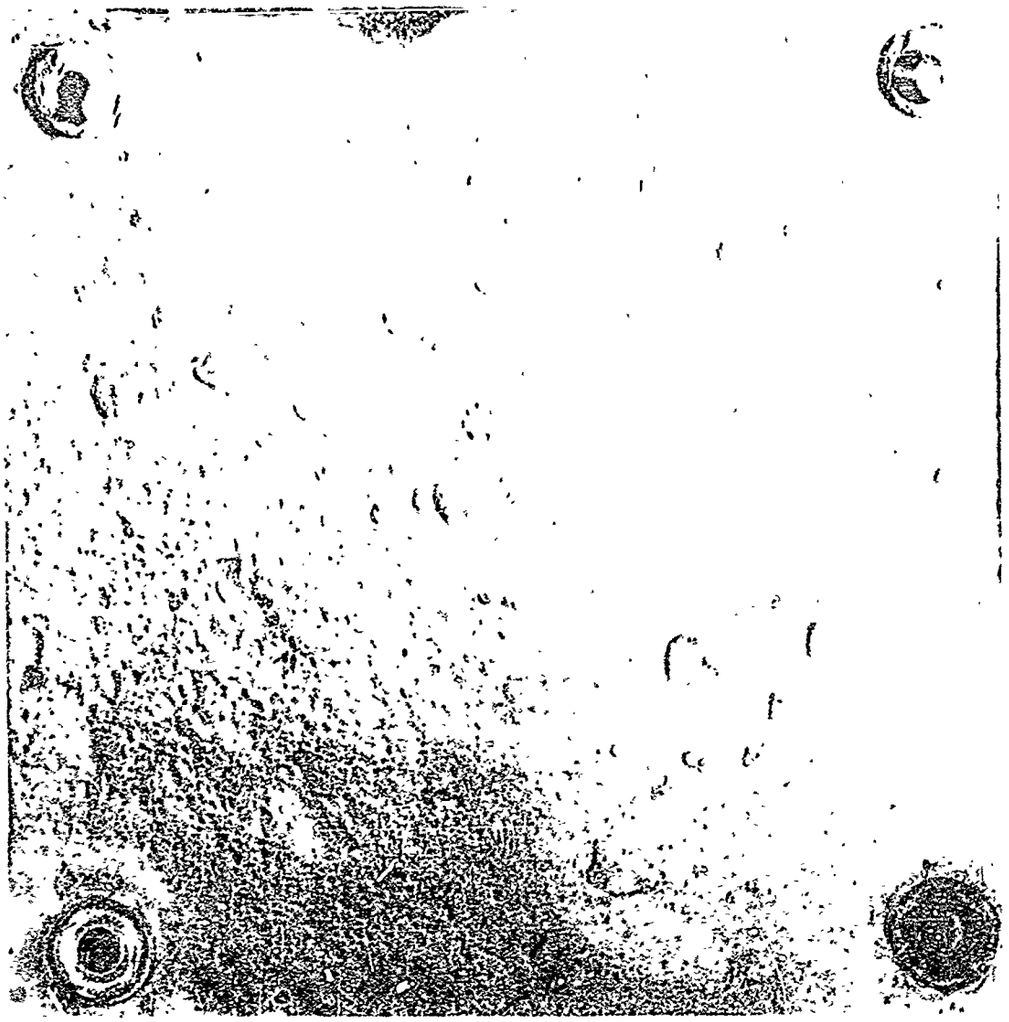


Figure 14. Coating Specimen RSA 64-6-A After Multiple Firing Test Nos. 4, 5, and 6

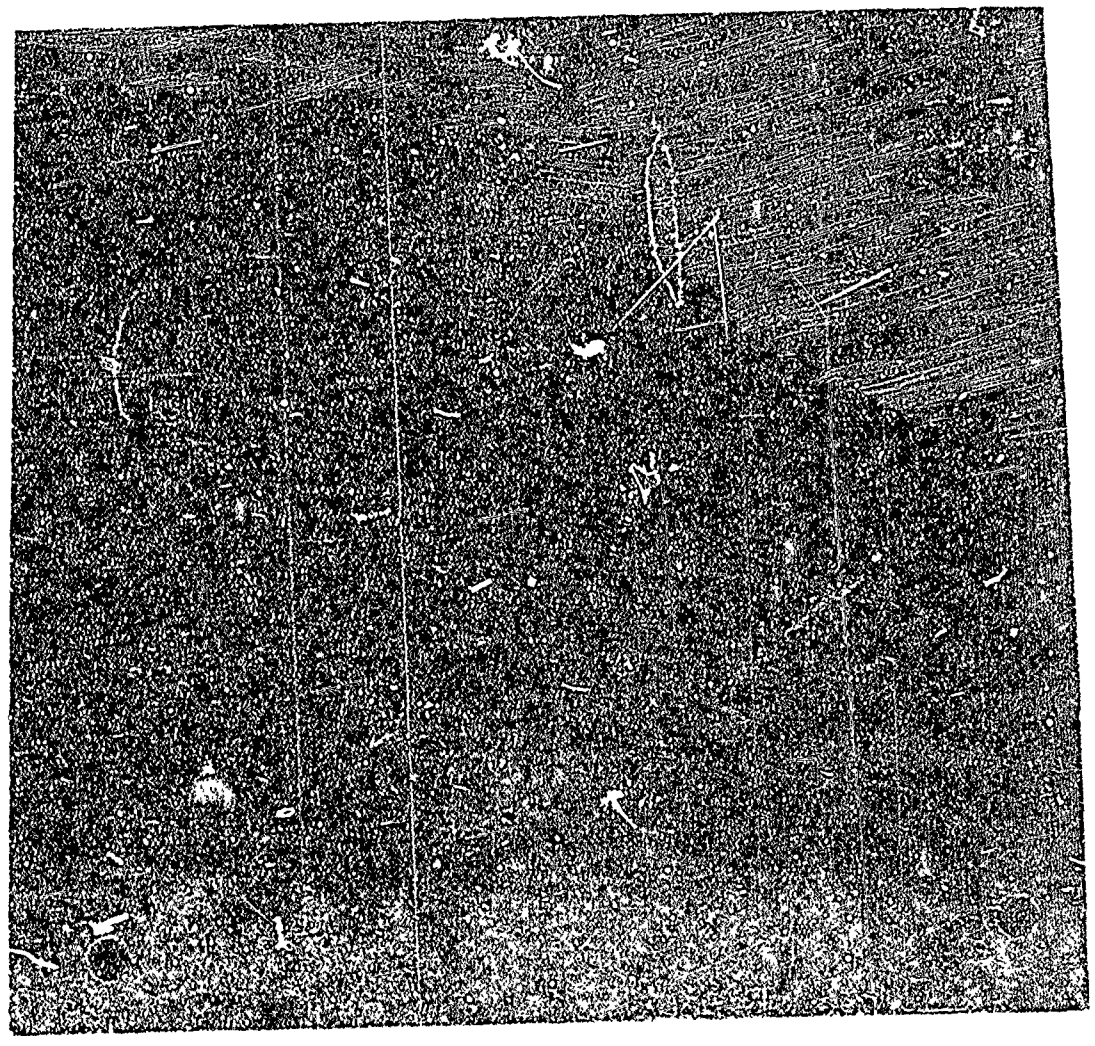


Figure 15. Coating Specimen RSA 64-7-A Before Test No. 1

Figure 16. Coating Specimen RSA 64-7-A After Test No. 1

Figure 17. Coating Specimen RSA 64-7-A After Test No. 2

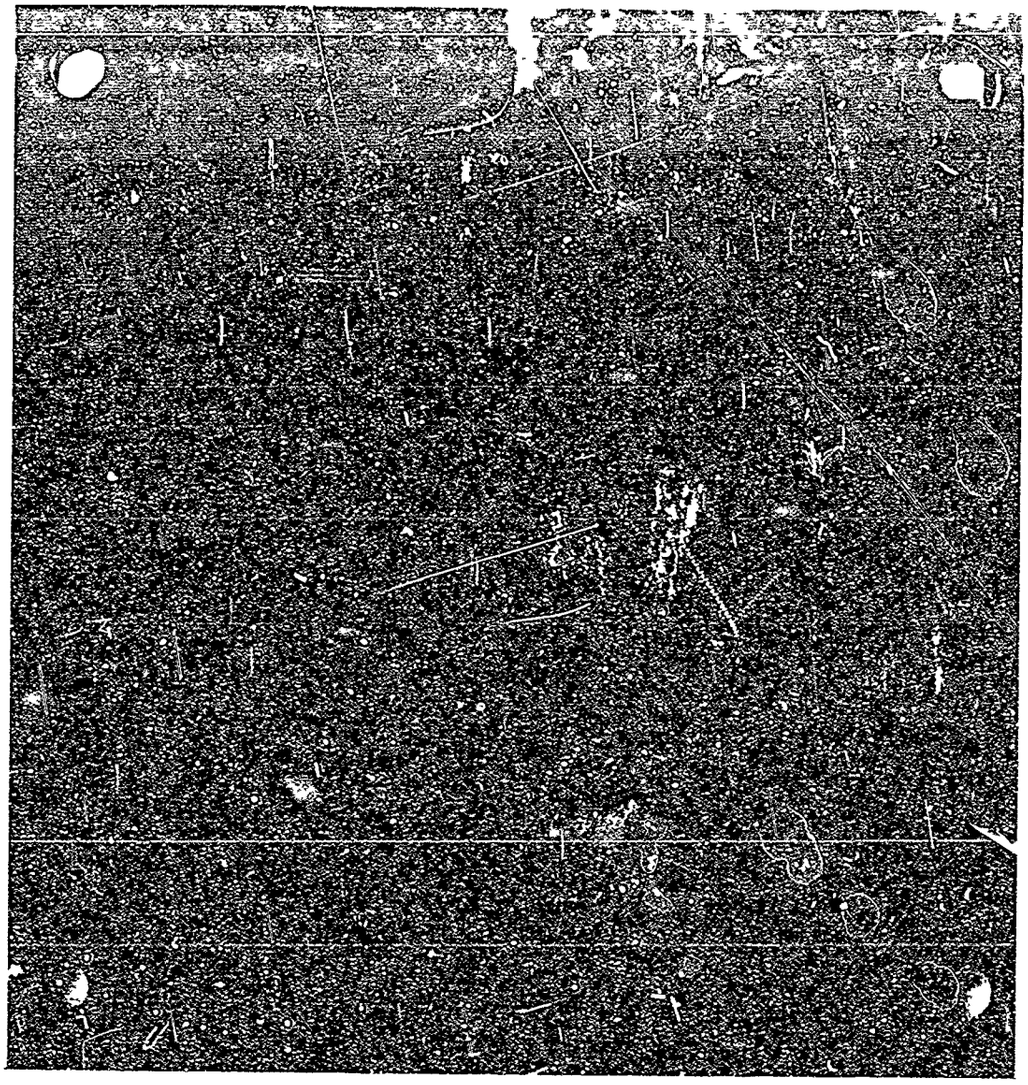


Figure 18. Coating Specimen RSA 64-14-A Before Test No. 1

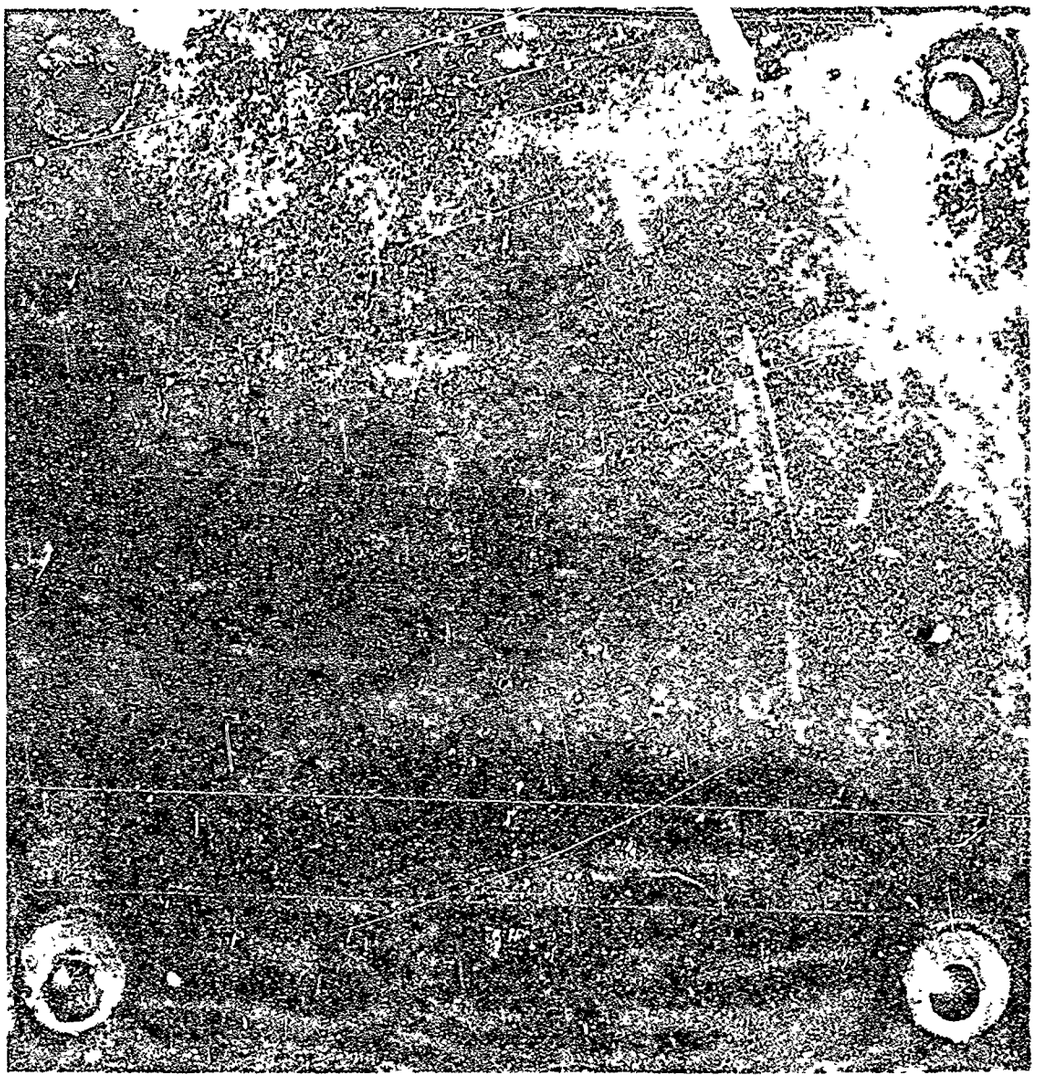


Figure 19. Coating Specimen RSA 64-14-A After Test No. 1

Figure 20. Coating Specimen RSA 64-14-A After Test No. 2

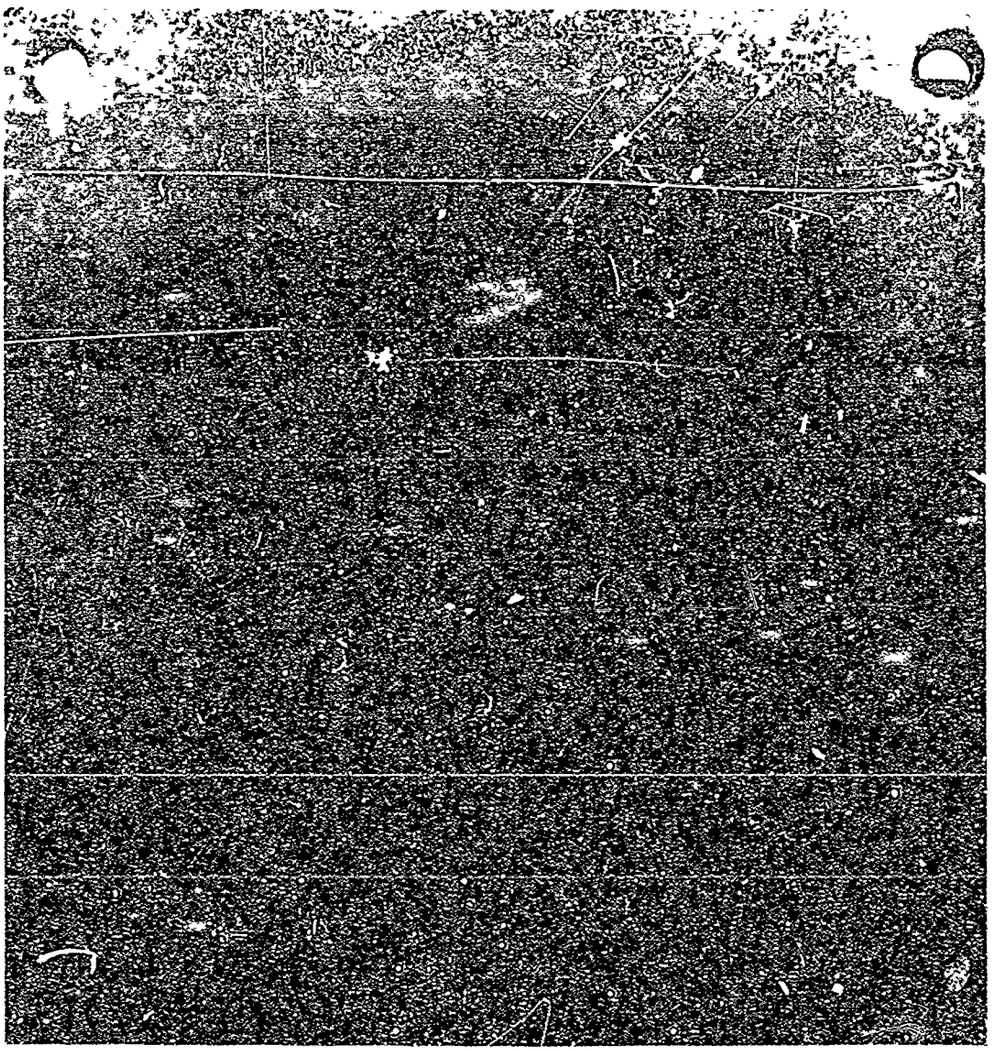


Figure 21. Coating Specimen RSA 64-15-A Before Test No. 1

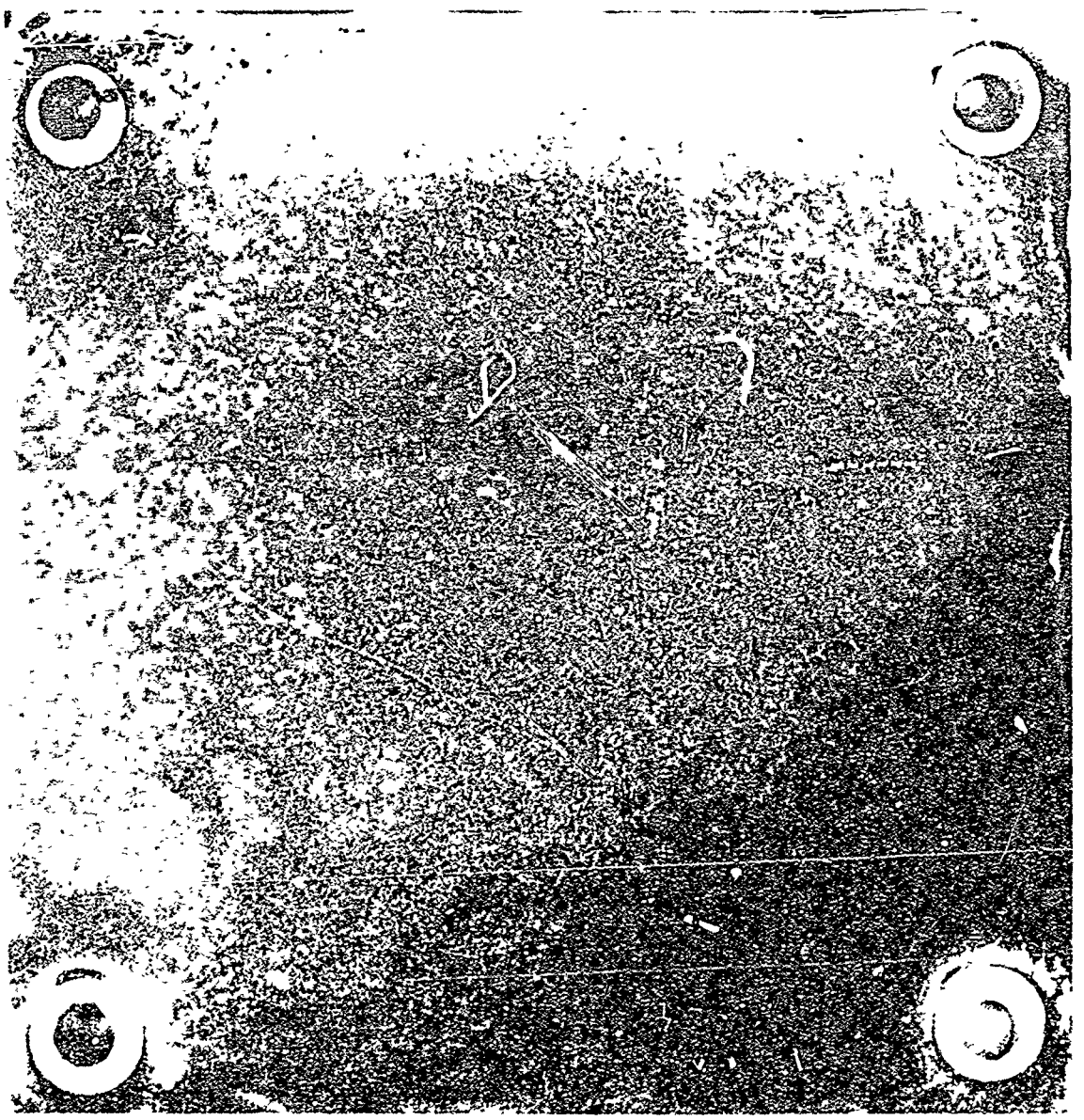


Figure 22. Coating Specimen RSA 64-15-A After Test No. 1

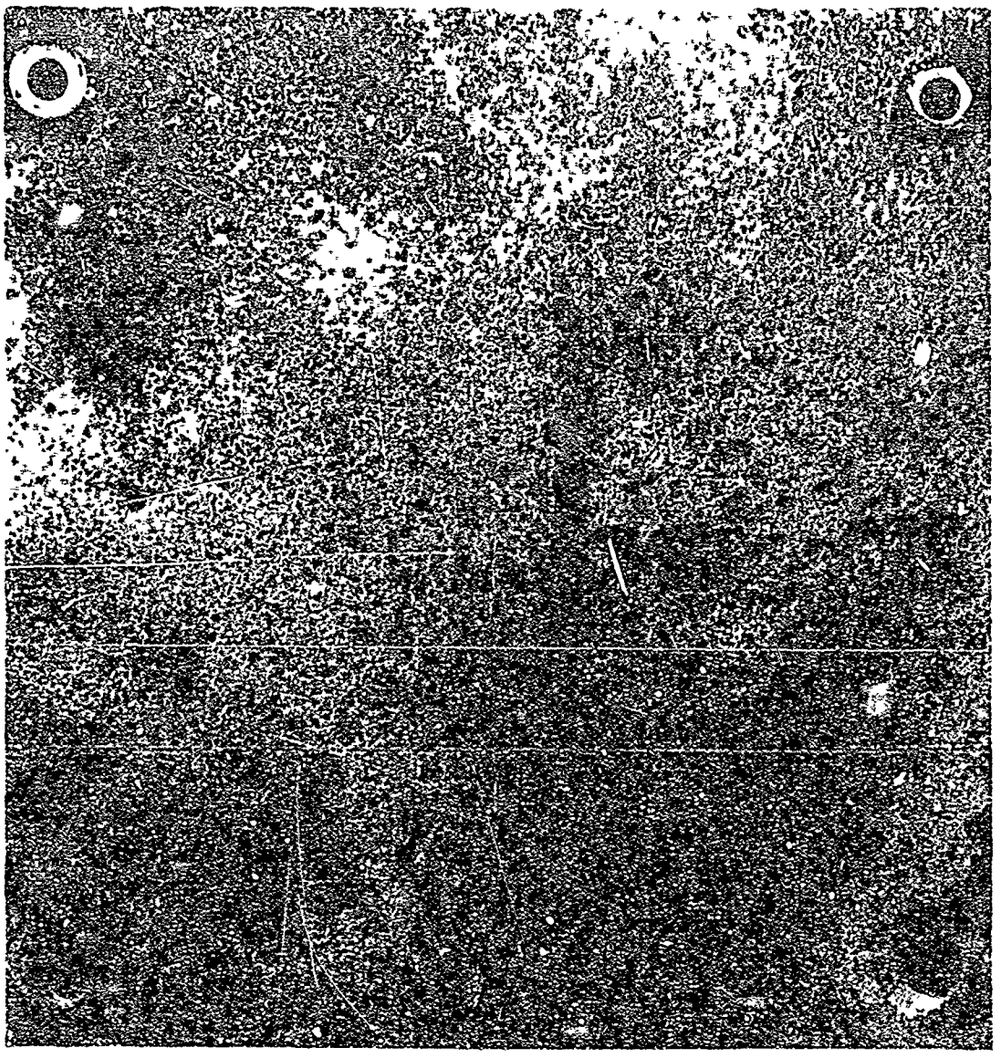


Figure 23. Coating Specimen RSA 64-15-A After Test No. 2

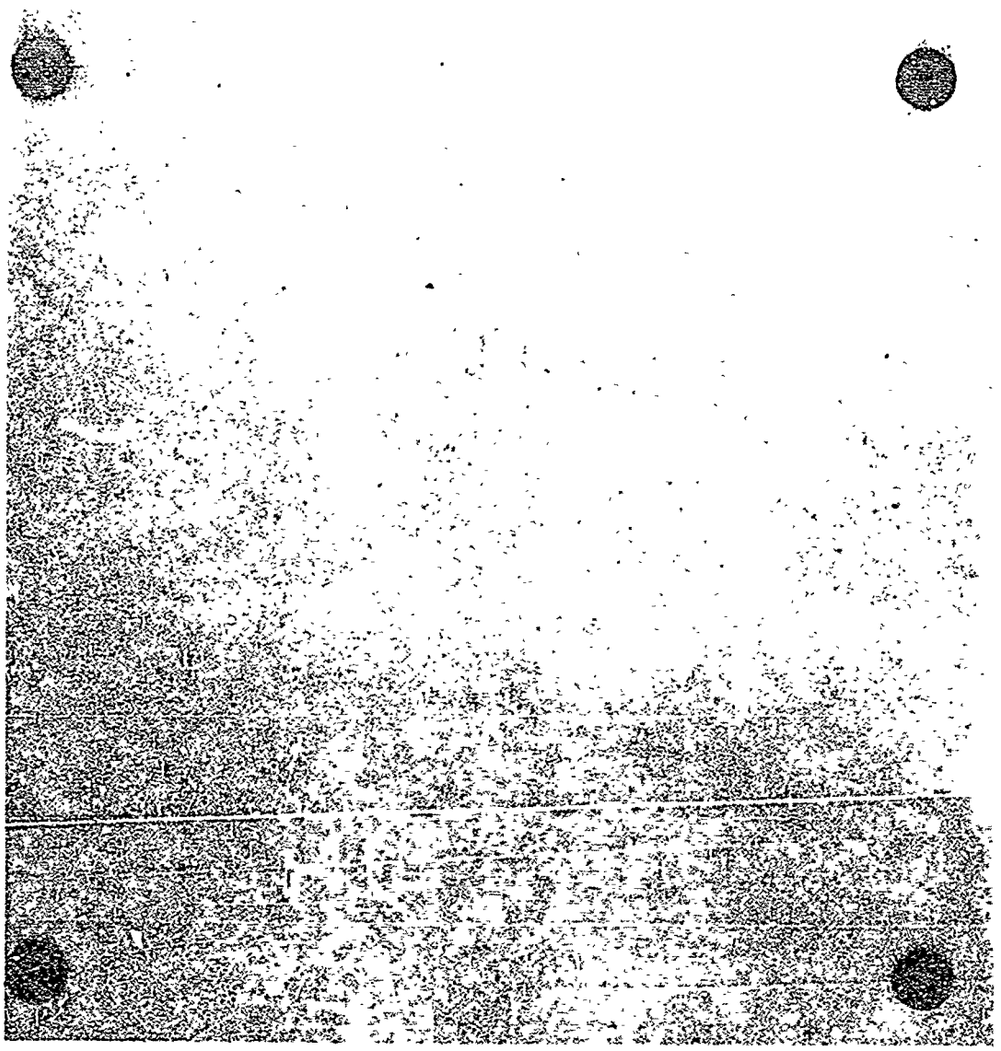


Figure 24. Coating Specimen RSA 64-17-A Before Test No. 1

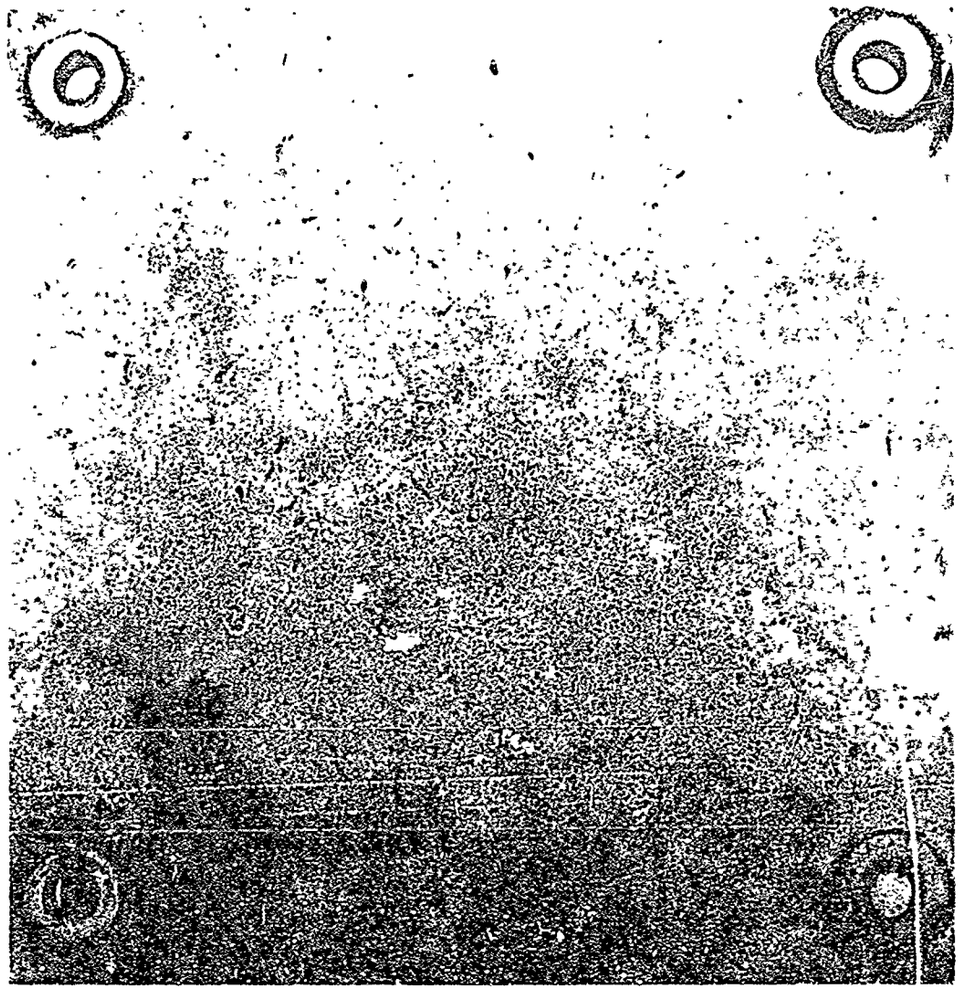


Figure 25. Coating Specimen RSA 64-17-A After Test No. 1

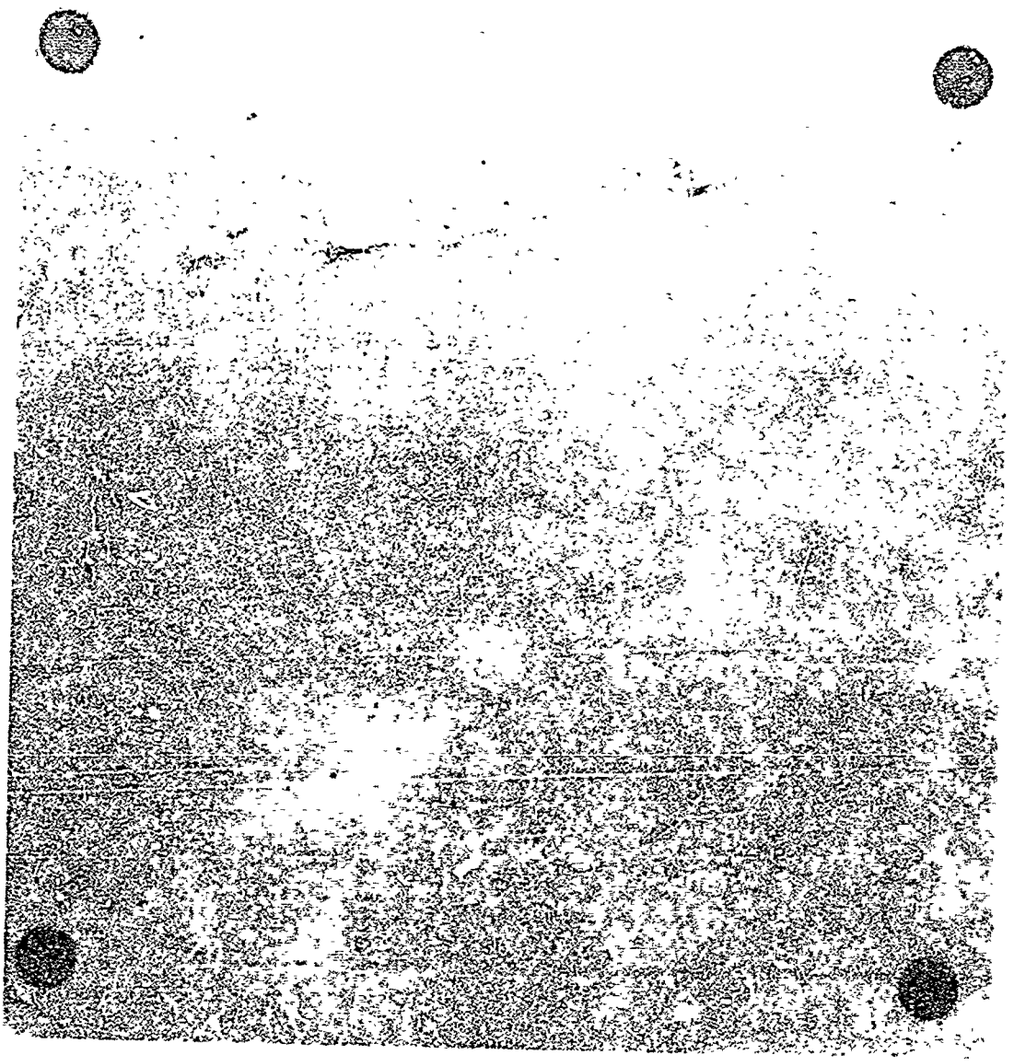


Figure 26. Coating Specimen RSA 64-18-A Before Test No. 1

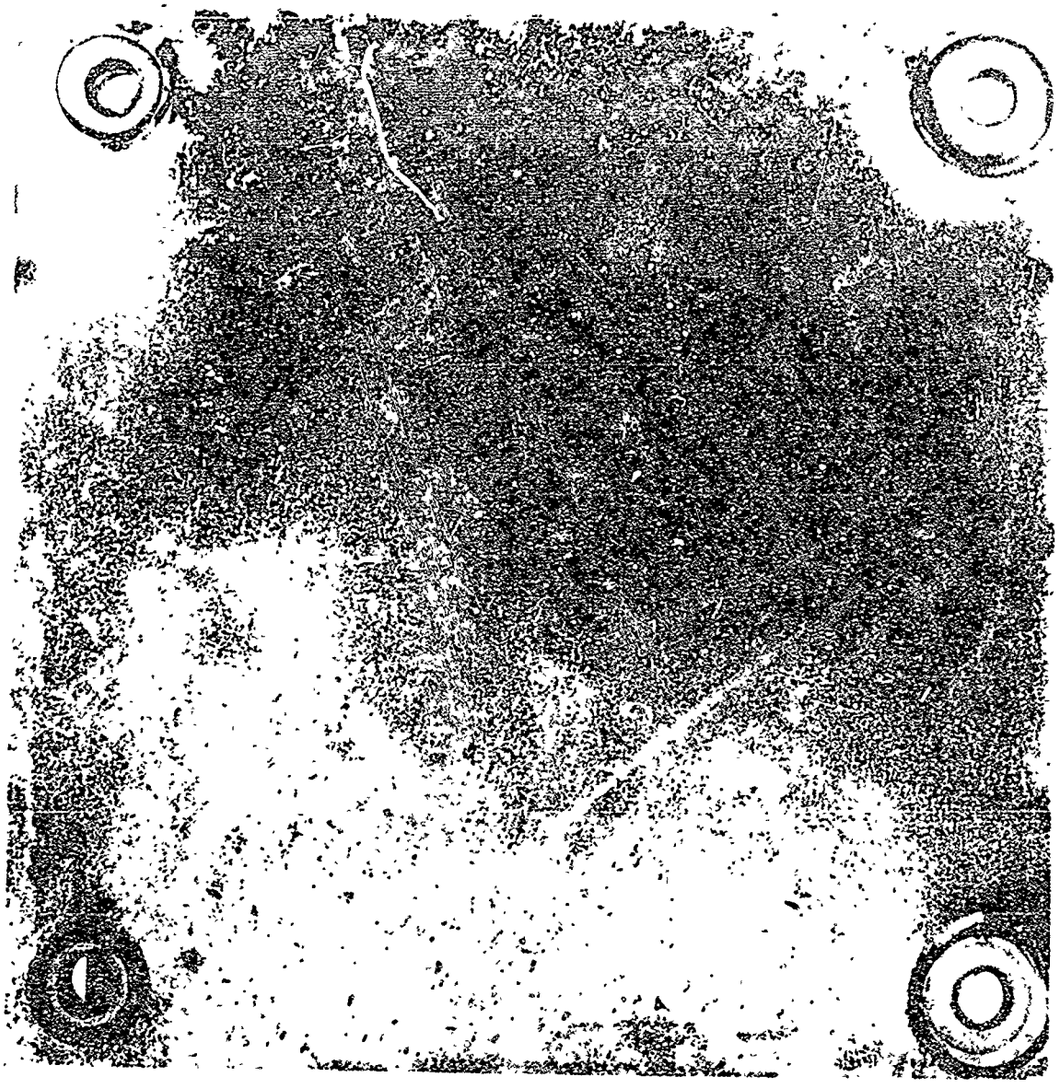


Figure 27. Coating Specimen RSA 64-18-A After Test No. 1

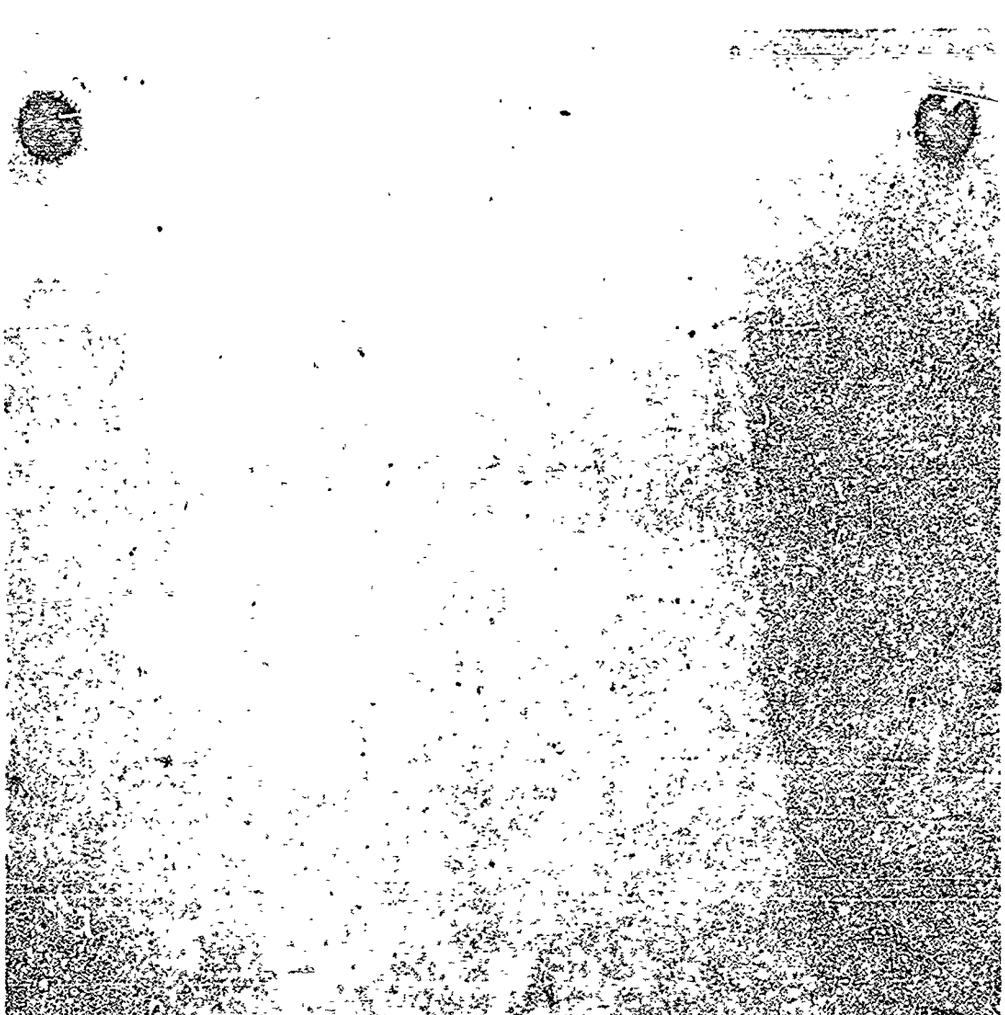


Figure 28. Coating Specimen RSA 64-19-A Before Test No. 1

Figure 29. Coating Specimen RSA 64-19-A After Test No. 1

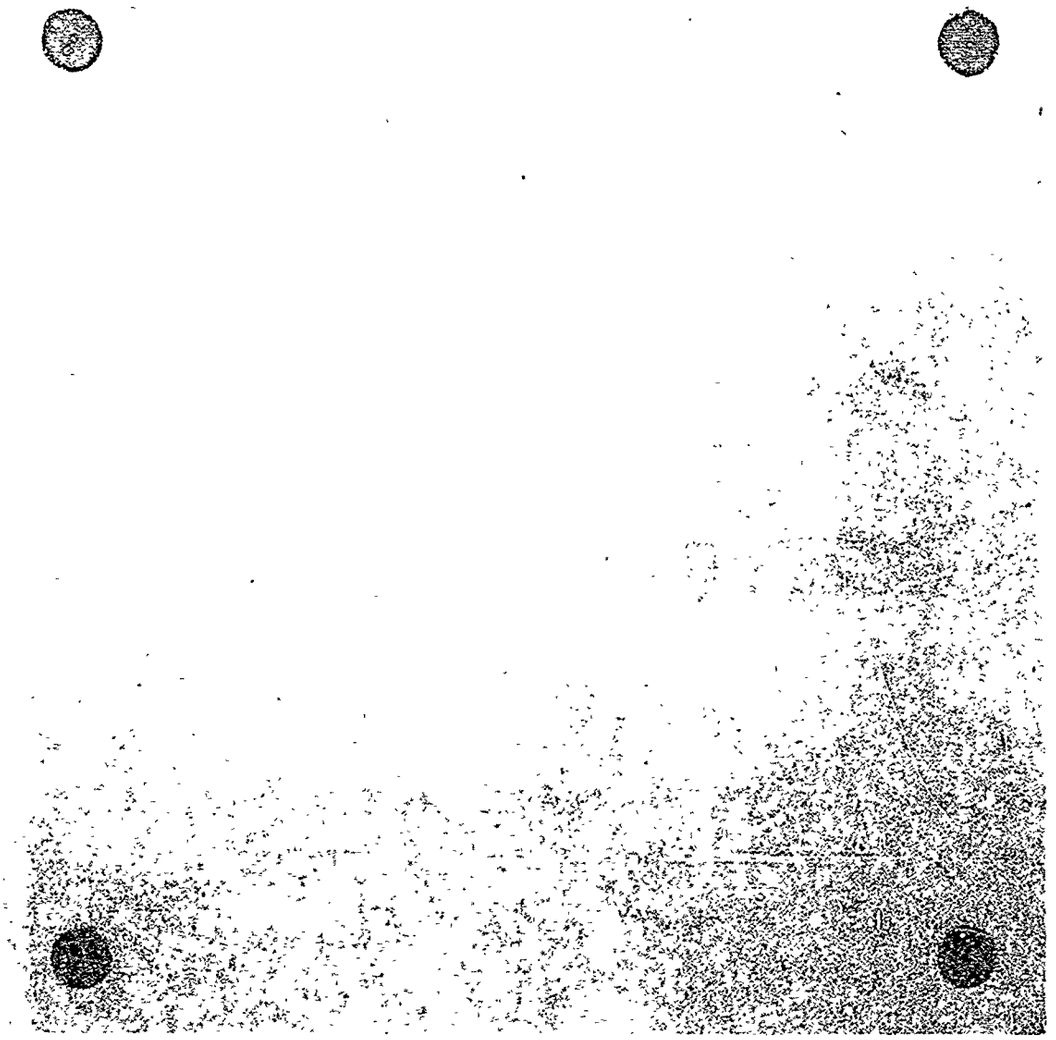


Figure 30. Coating Specimen RSA 64-20-A Before Test No. 1

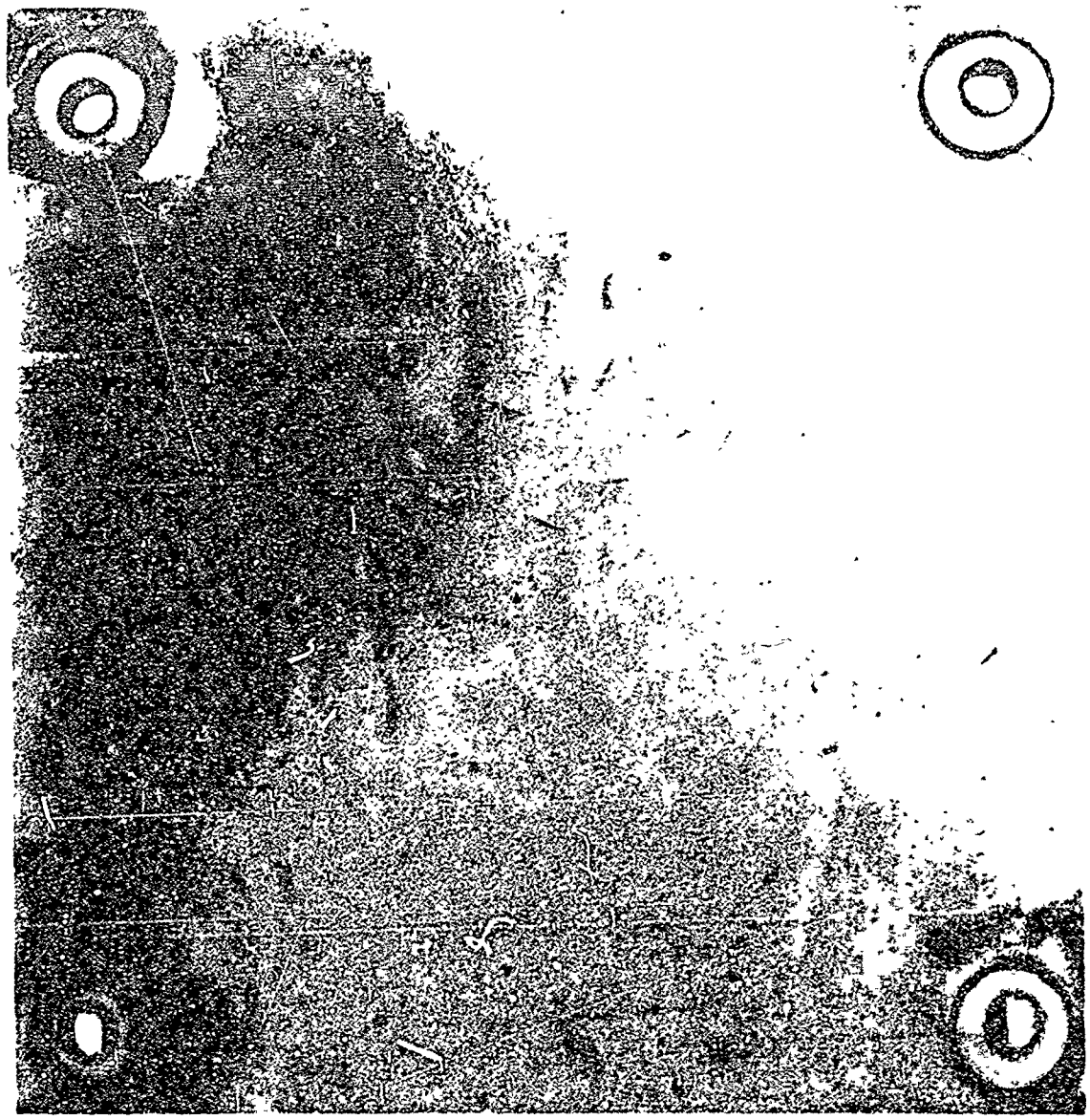


Figure 31. Coating Specimen RSA 64-20-A After Test No. 1

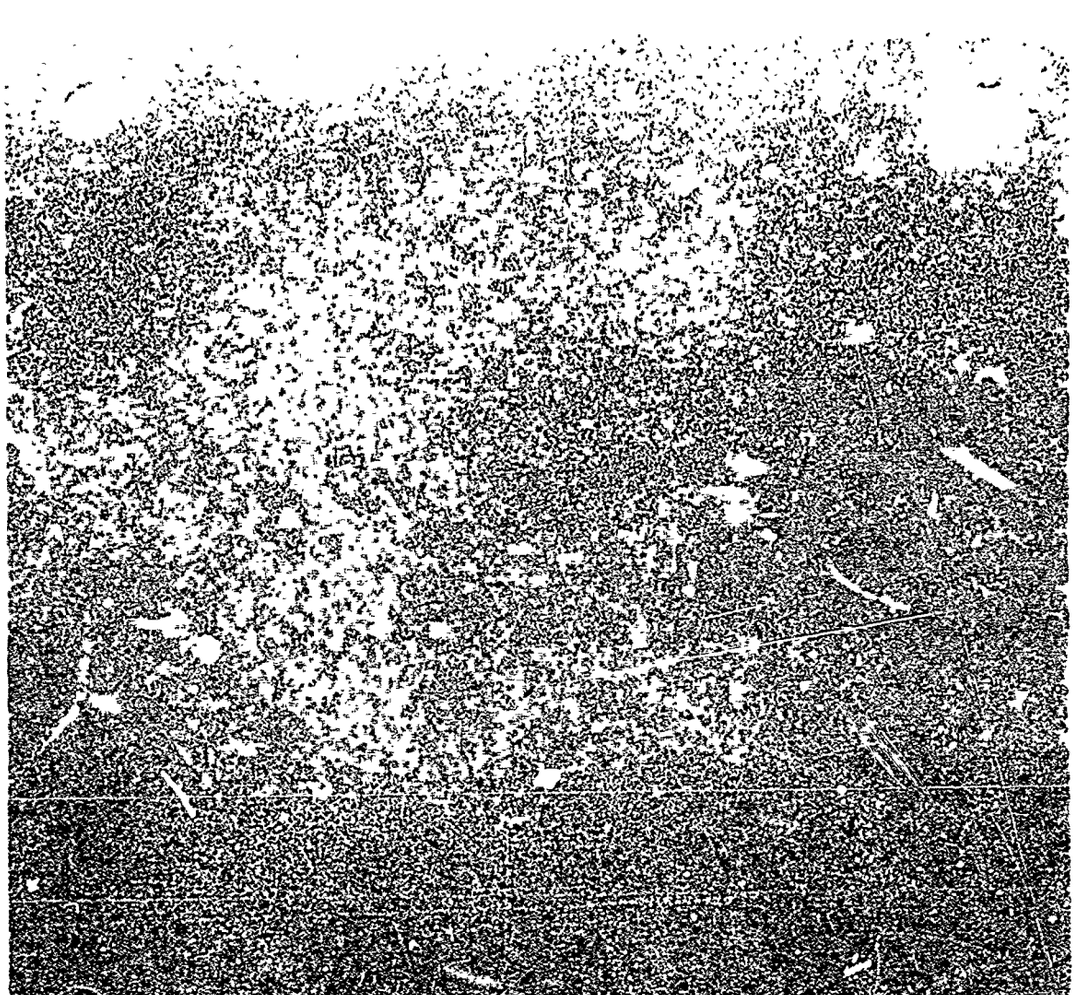


Figure 32. Coating Specimen RSA 64-21-A Before Test No. 1

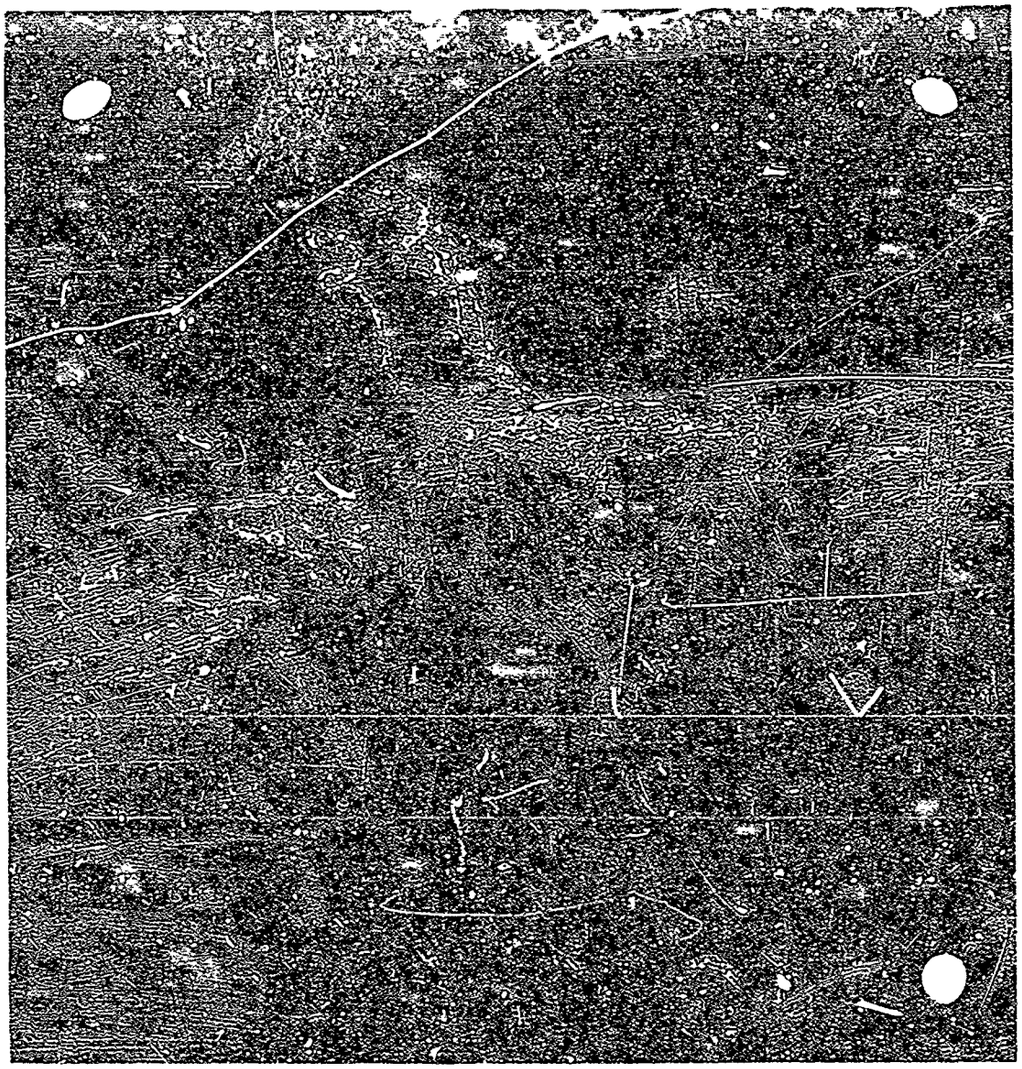


Figure 33. Coating Specimen RSA 64-21-A After Test No. 1

Figure 34. Coating Specimen RSA 64-21-A After Multiple Firing Test Nos. 2, 3, and 4

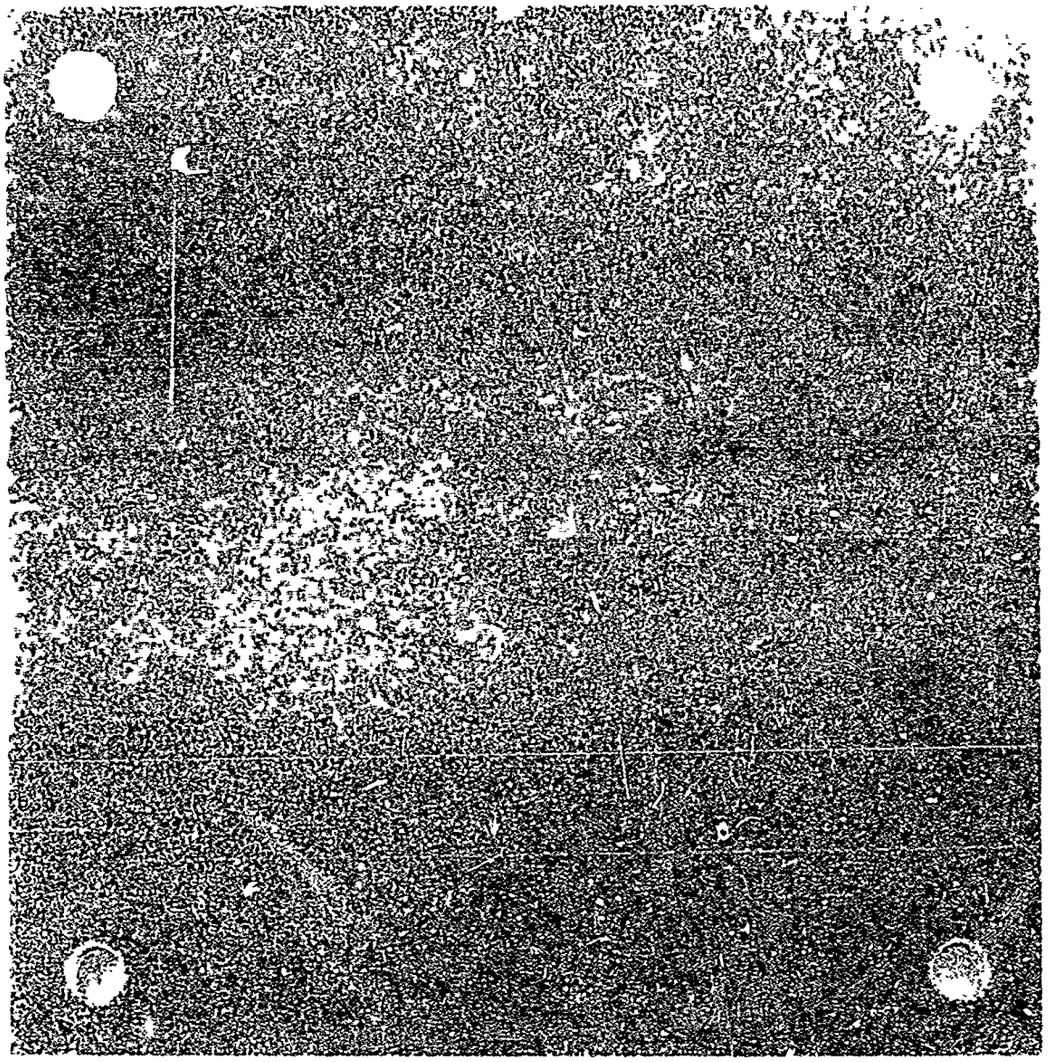


Figure 35. Coating Specimen RSA 64-22-A Before Test No. 1

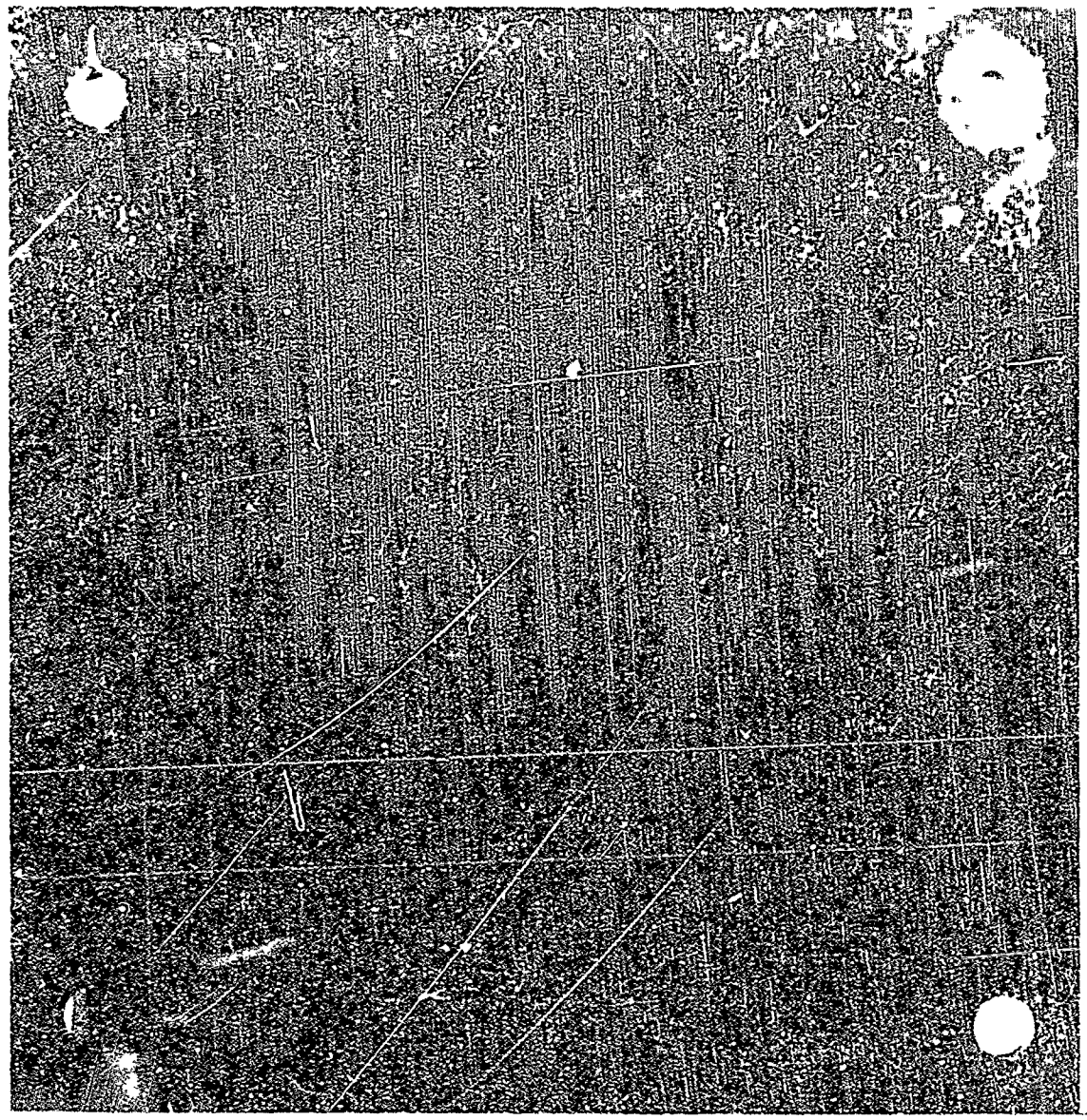


Figure 36. Coating Specimen RSA 64-22-A After Test No. 1

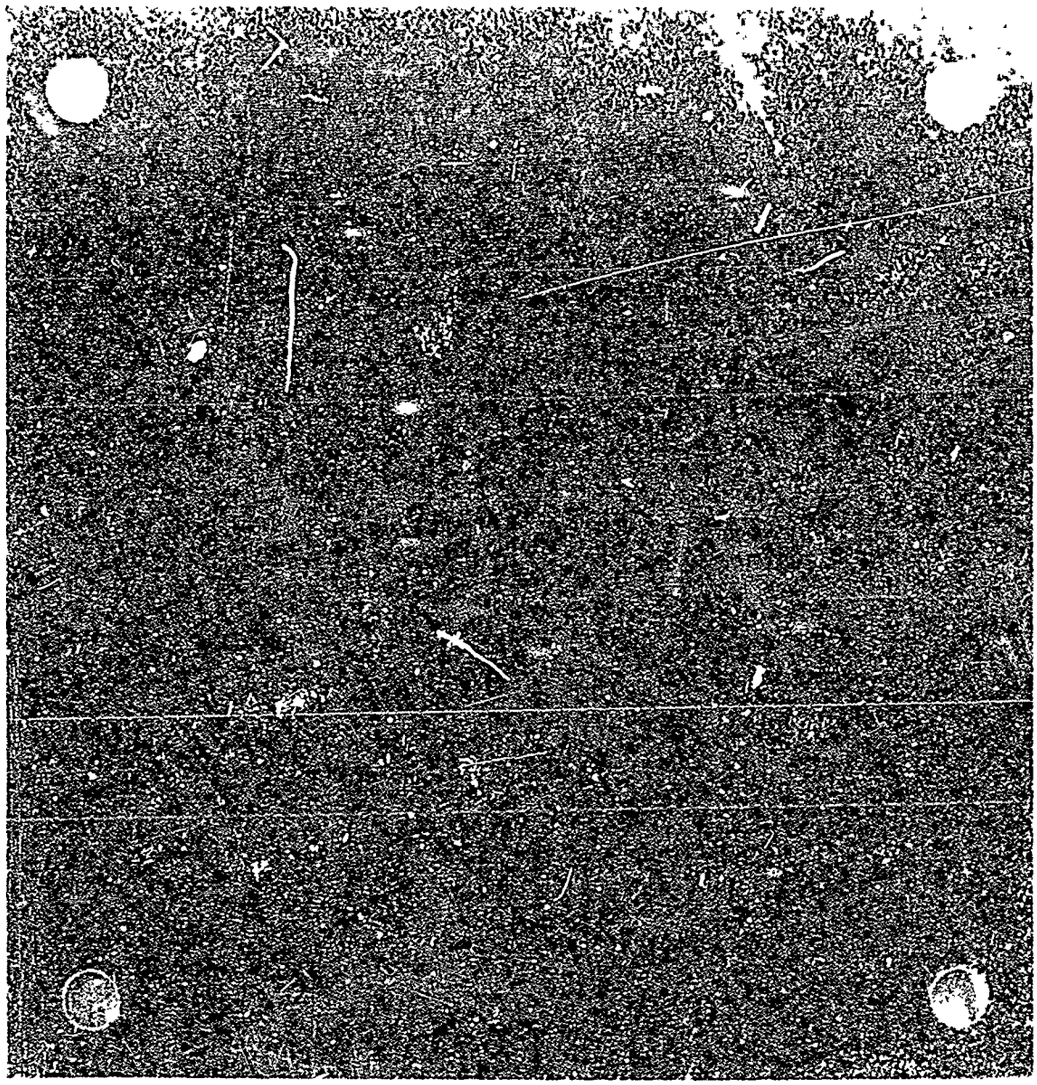


Figure 37. Coating Specimen RSA 64-23-A Before Test No. 1

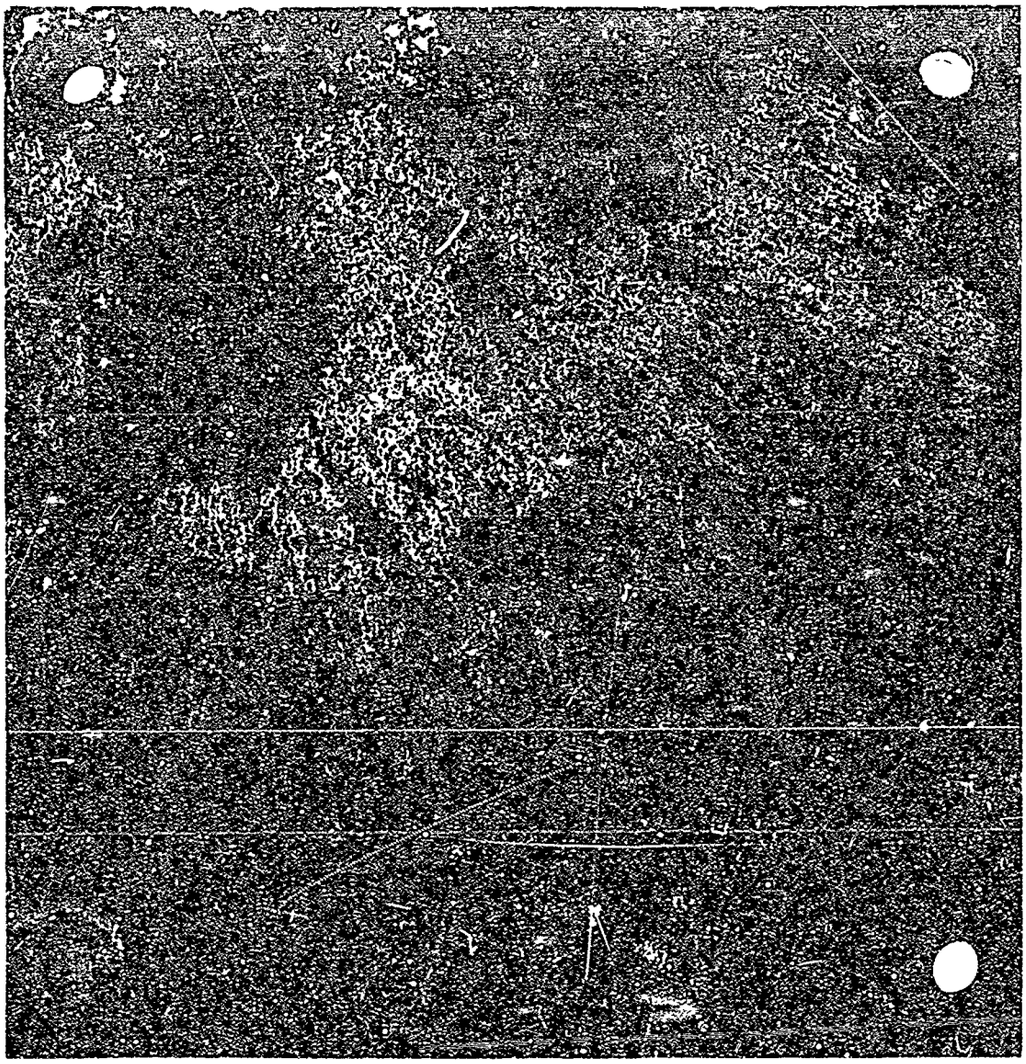


Figure 38. Coating Specimen RSA 64-23-A After Test No. 1

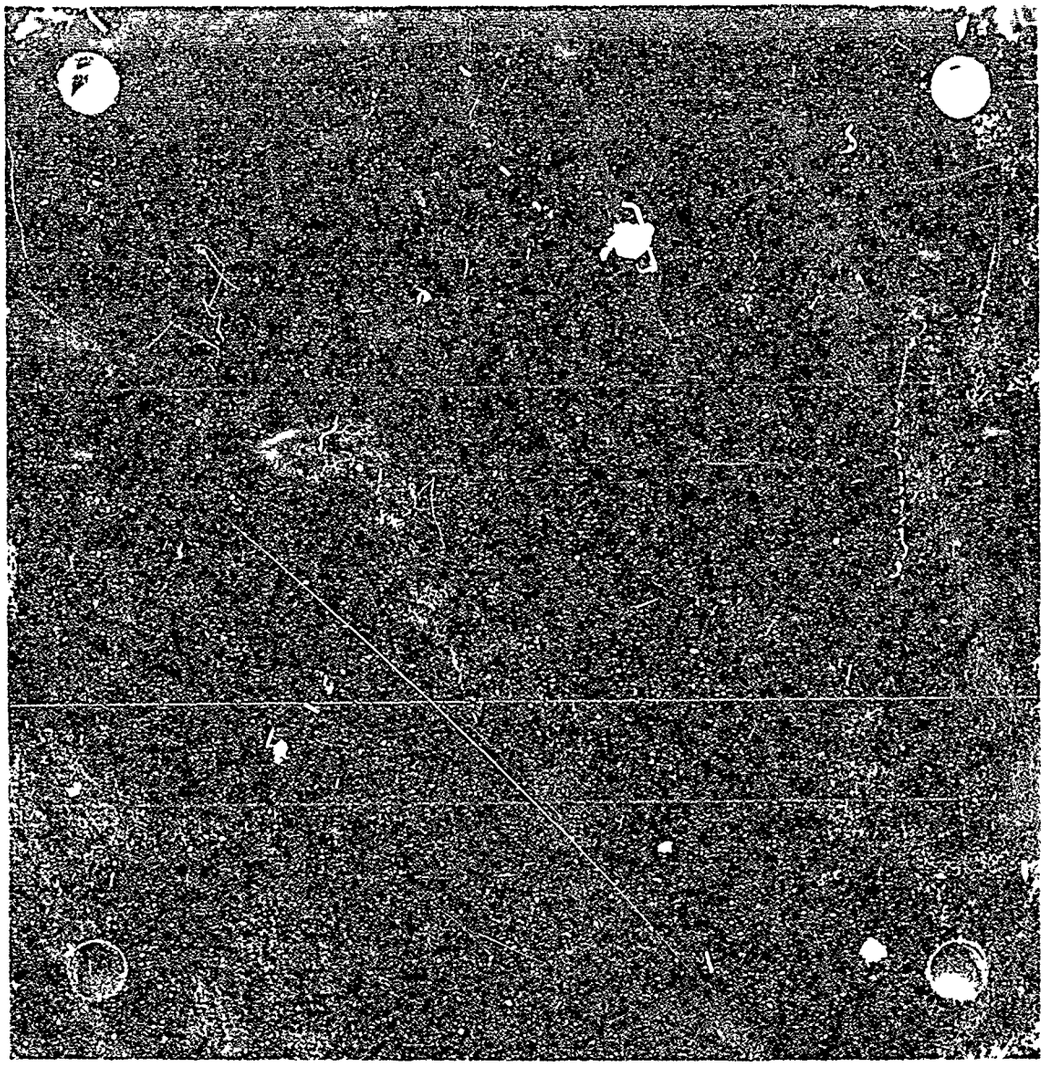


Figure 39. Coating Specimen RSA 64-24-A Before Test No. 1

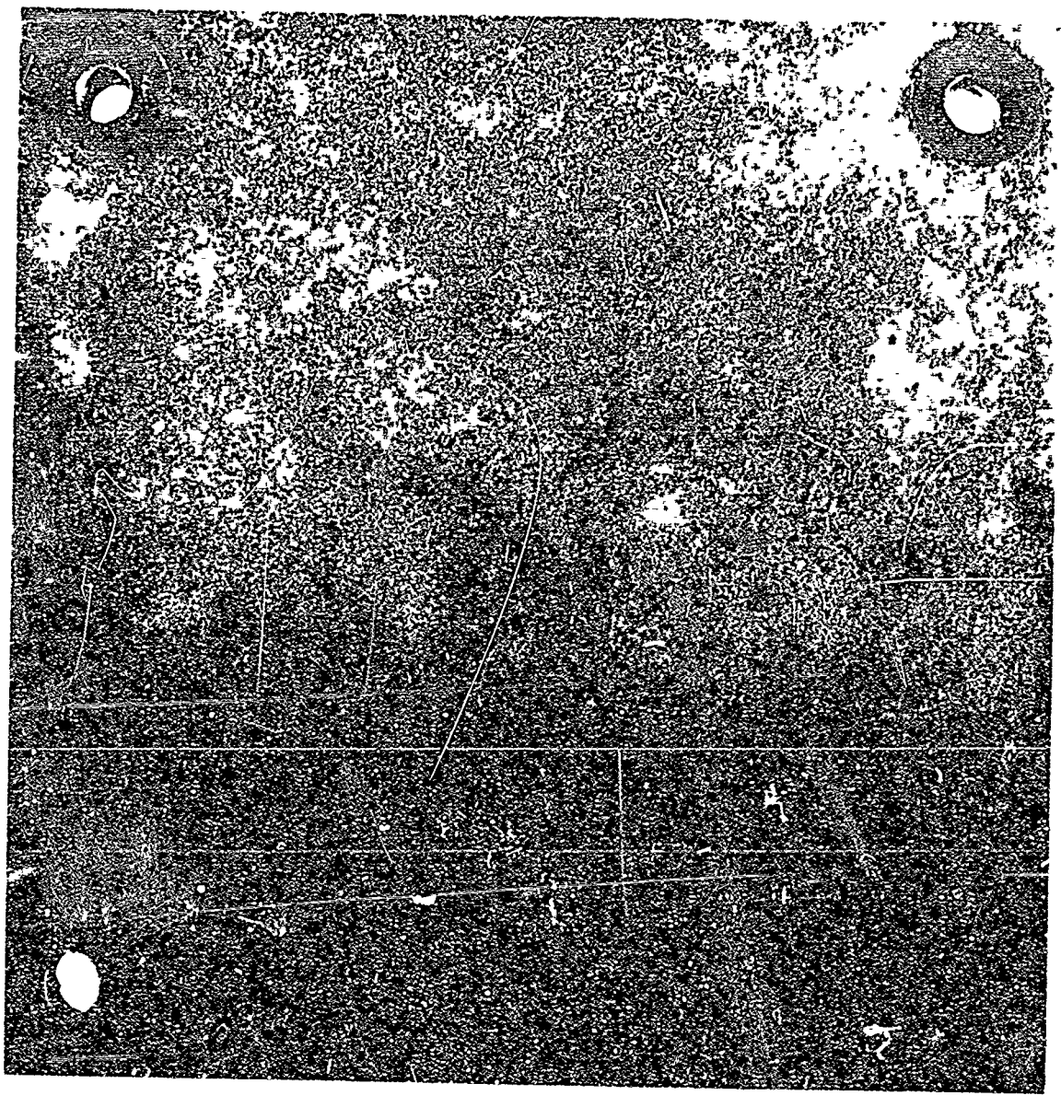


Figure 40. Coating Specimen RSA 64-24-A After Test No. 1

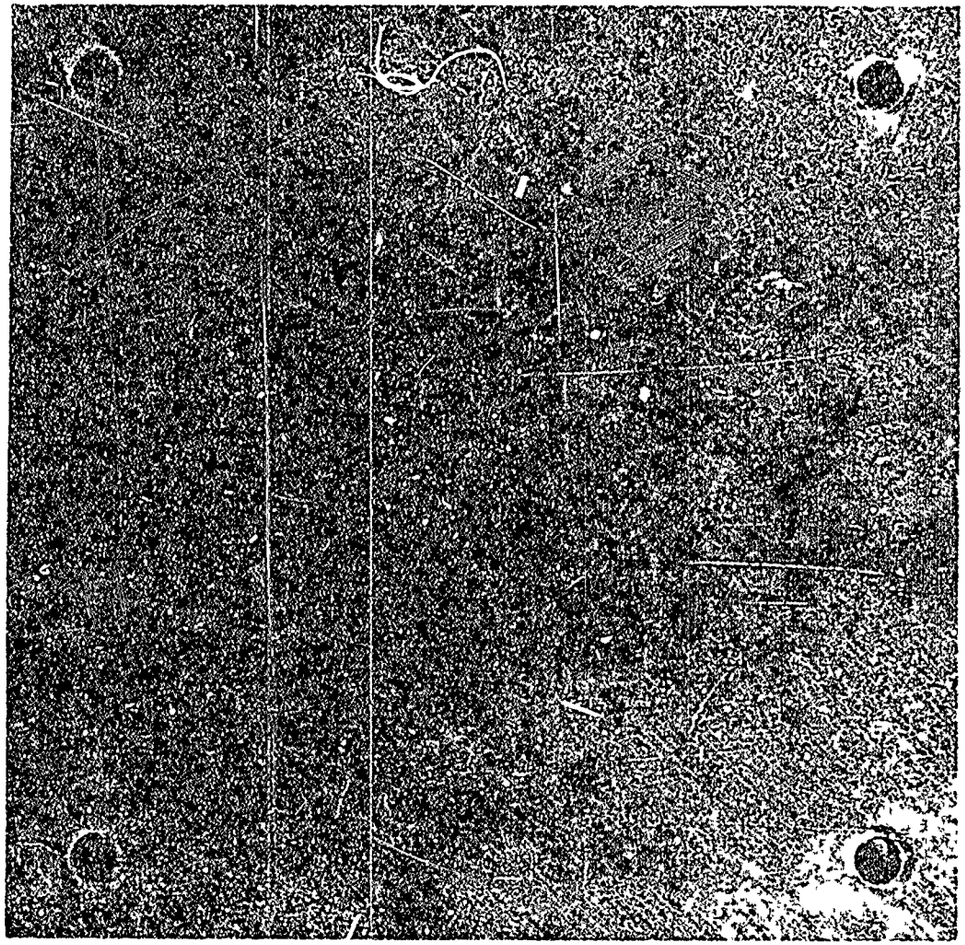


Figure 41. Coating Specimen RSA 64-25 Before Test No. 1

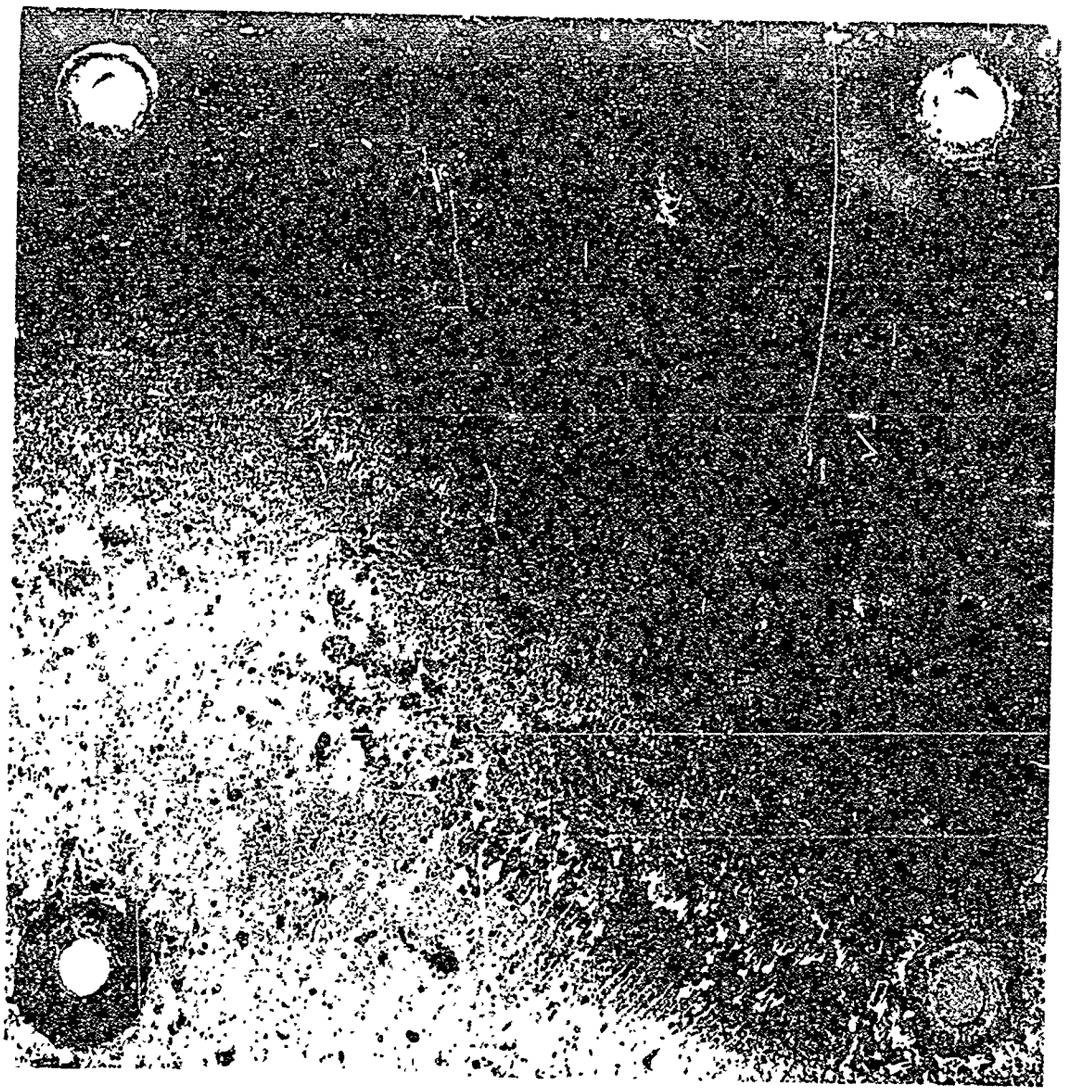


Figure 42. Coating Specimen RSA 64-25 After Test No. 1

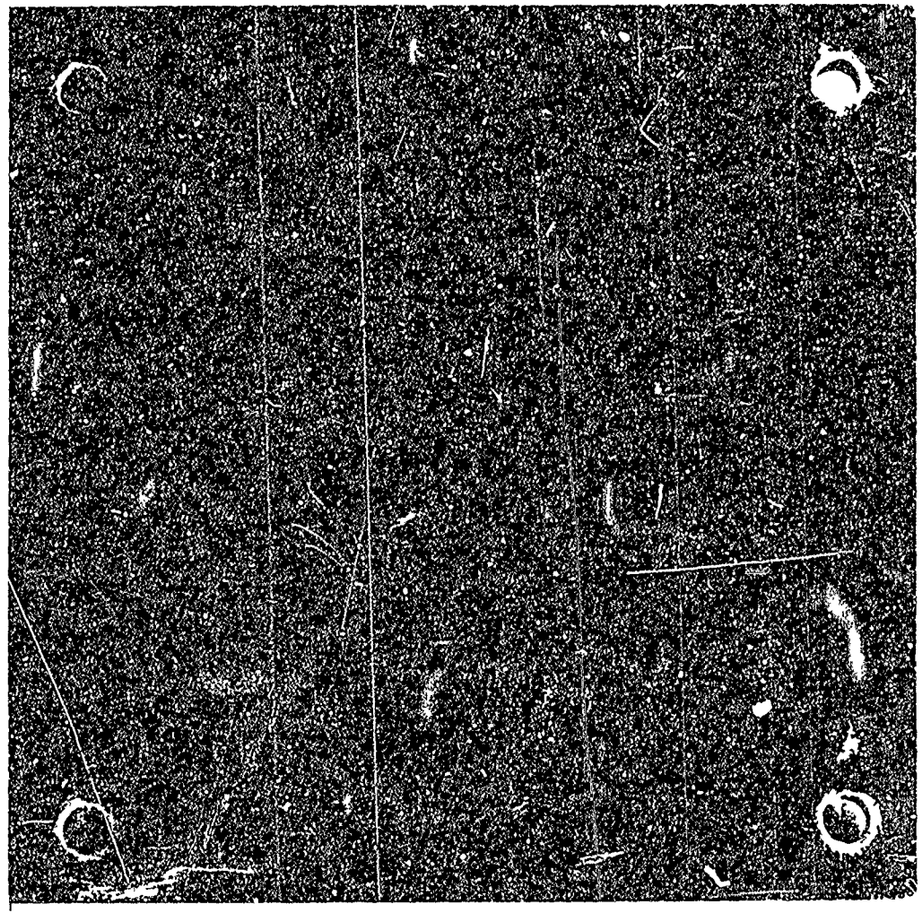


Figure 43. Coating Specimen RSA 64-26 Before Test No. 1

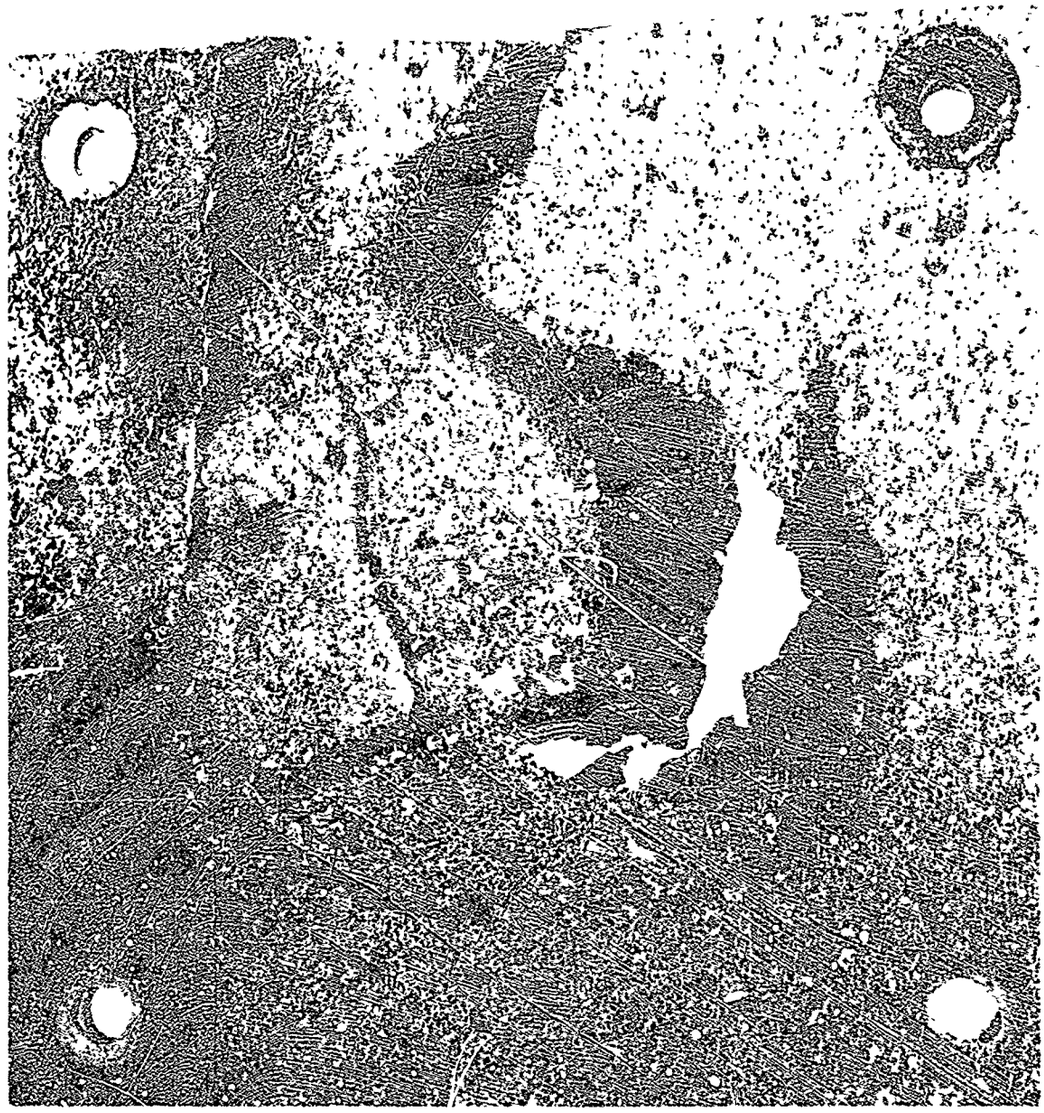


Figure 44. Coating Specimen RSA 64-26 After Test No. 1

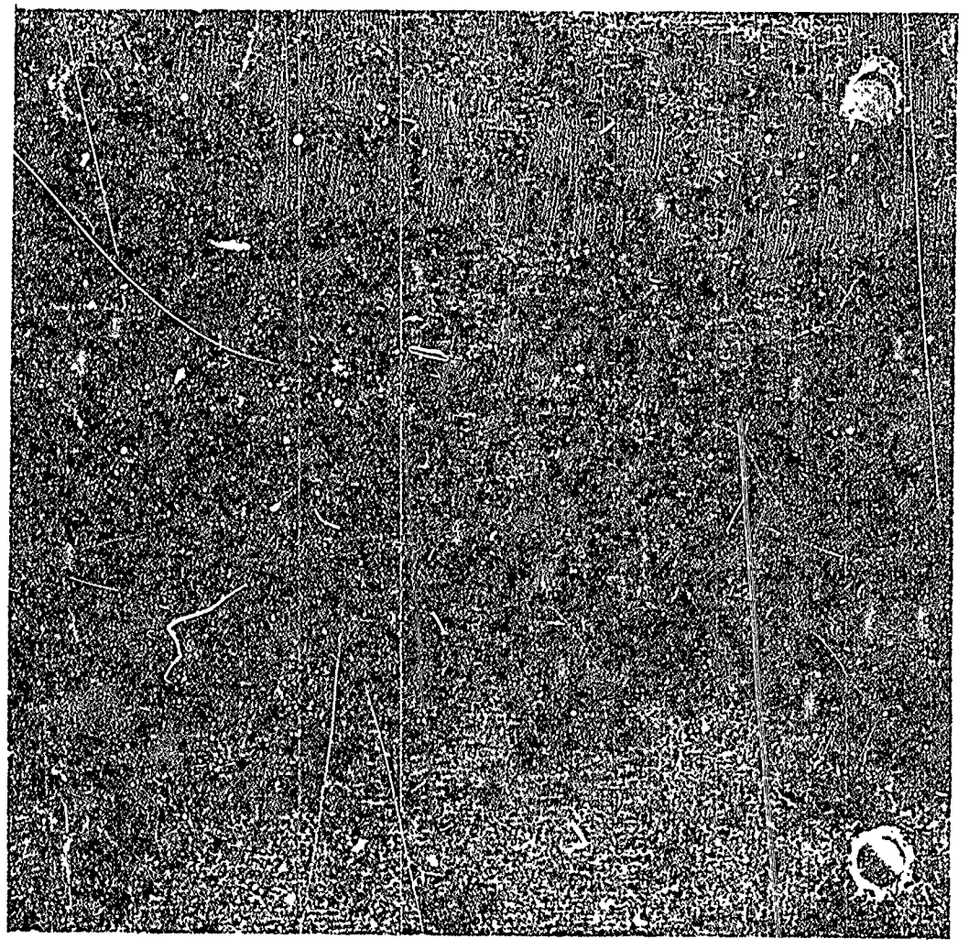


Figure 45. Coating Specimen RSA 64-27 Before Test No. 1

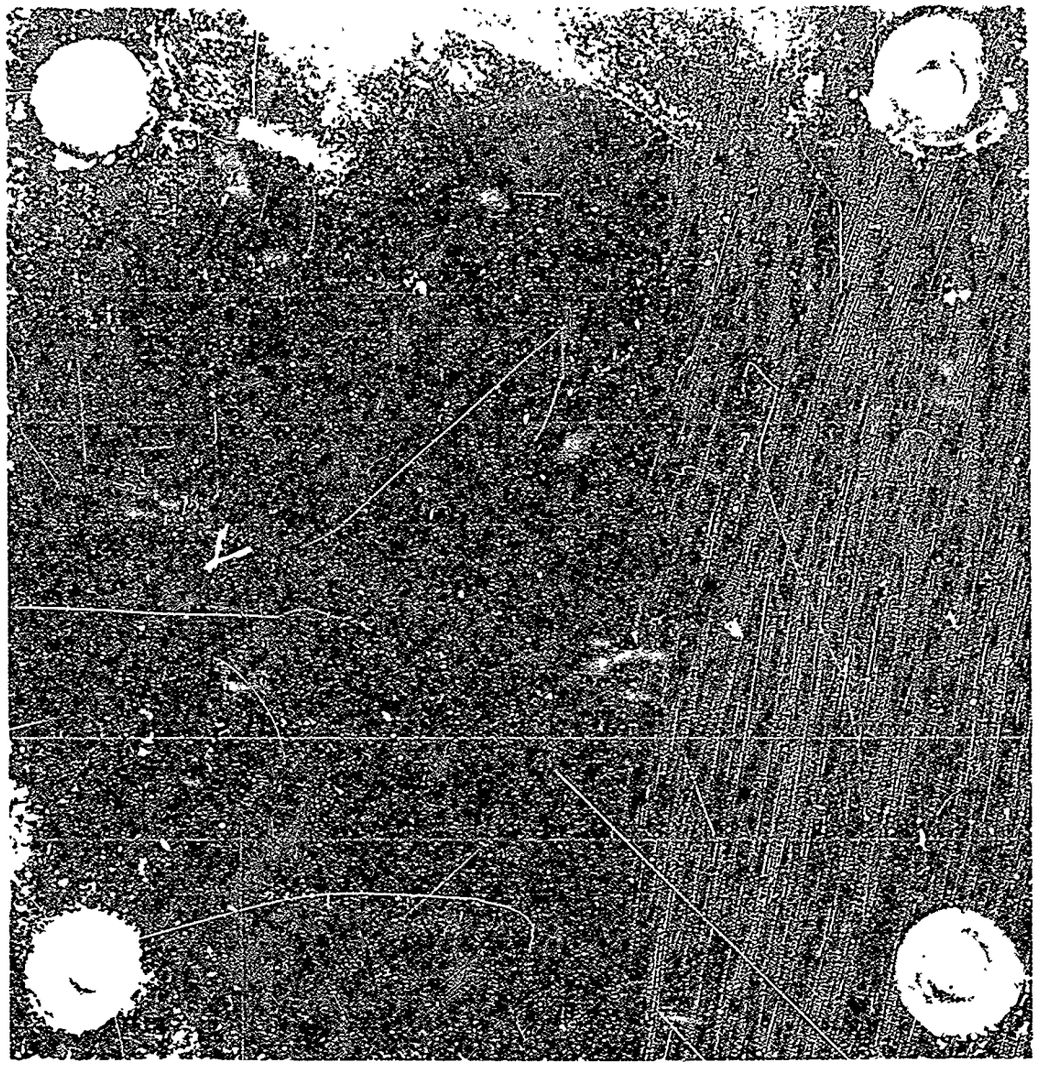


Figure 46. Coating Specimen RSA 64-27 After Test No. 1

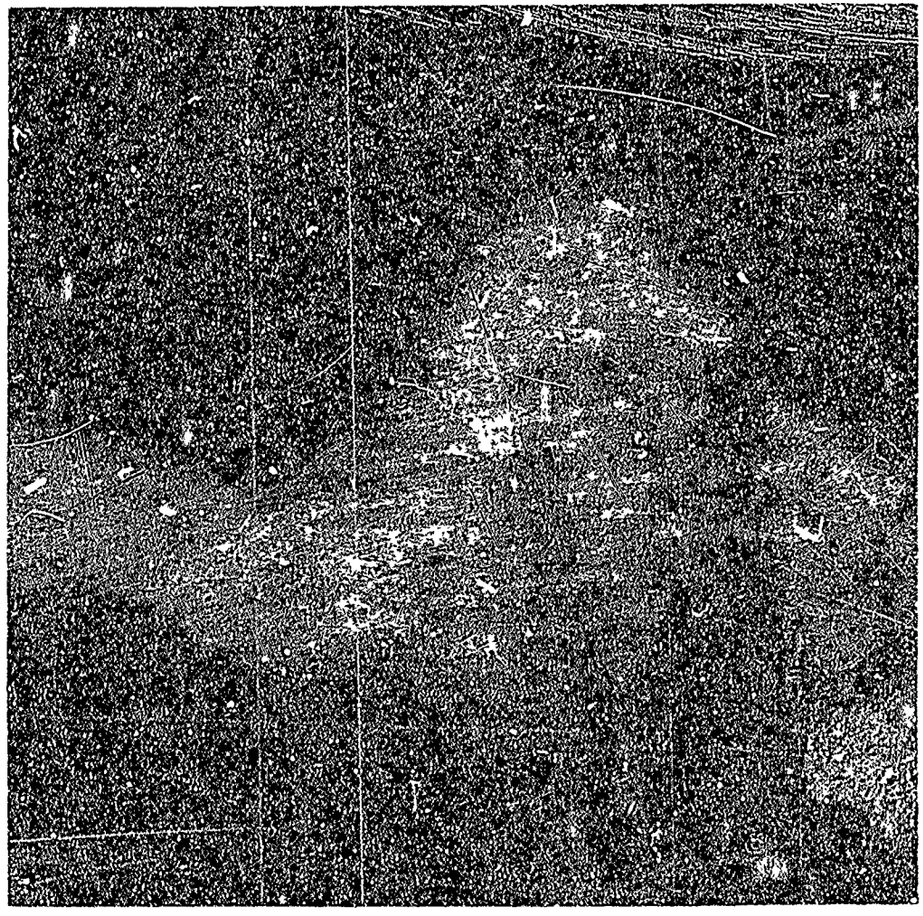


Figure 47. Coating Specimen RSA 64-28-SS Before Test No. 1

Figure 48. Coating Specimen RSA 64-28-SS After Test No. 1

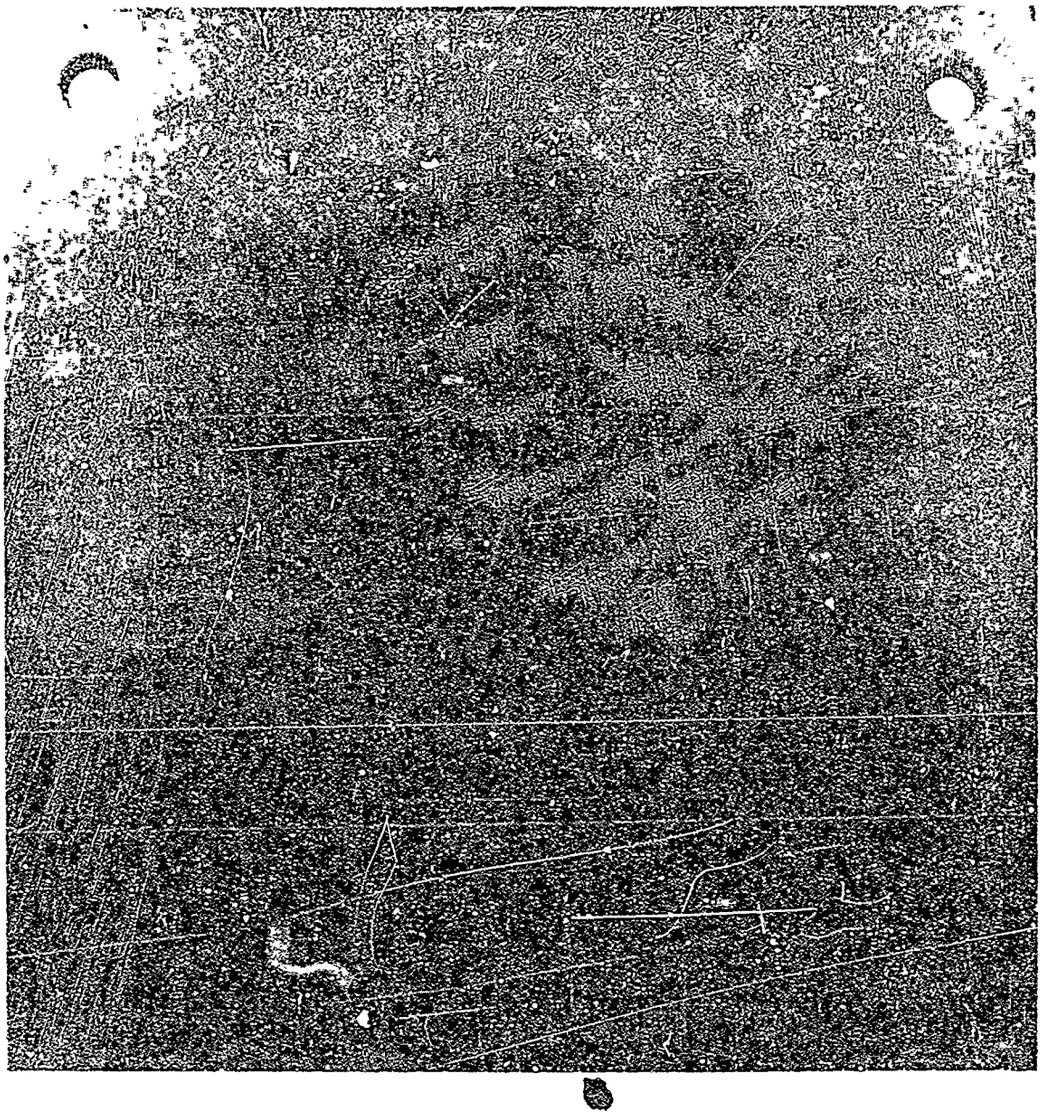


Figure 49. Coating Specimen RSA 64-29-A Before Test No. 1

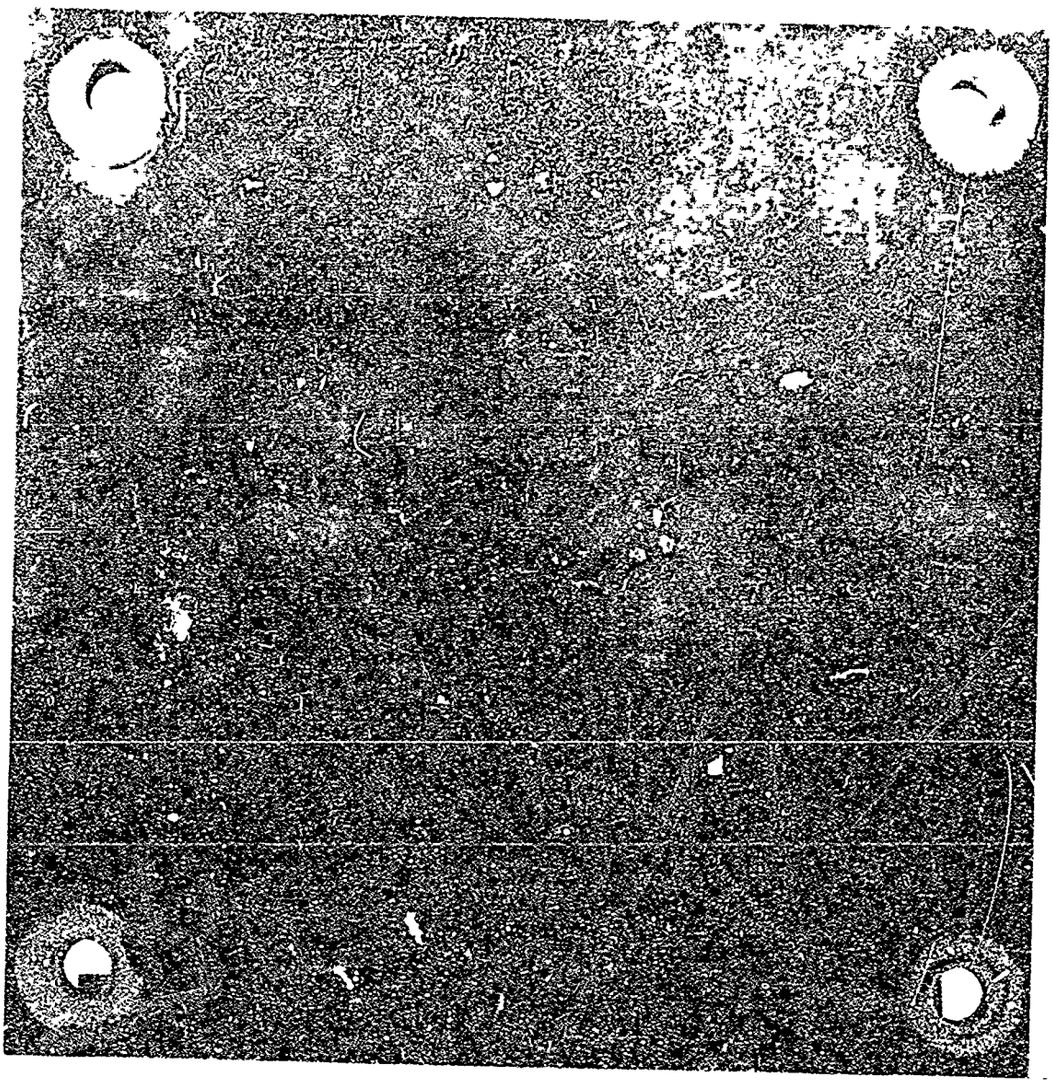


Figure 50. Coating Specimen RSA 64-29-A After Test No. 1

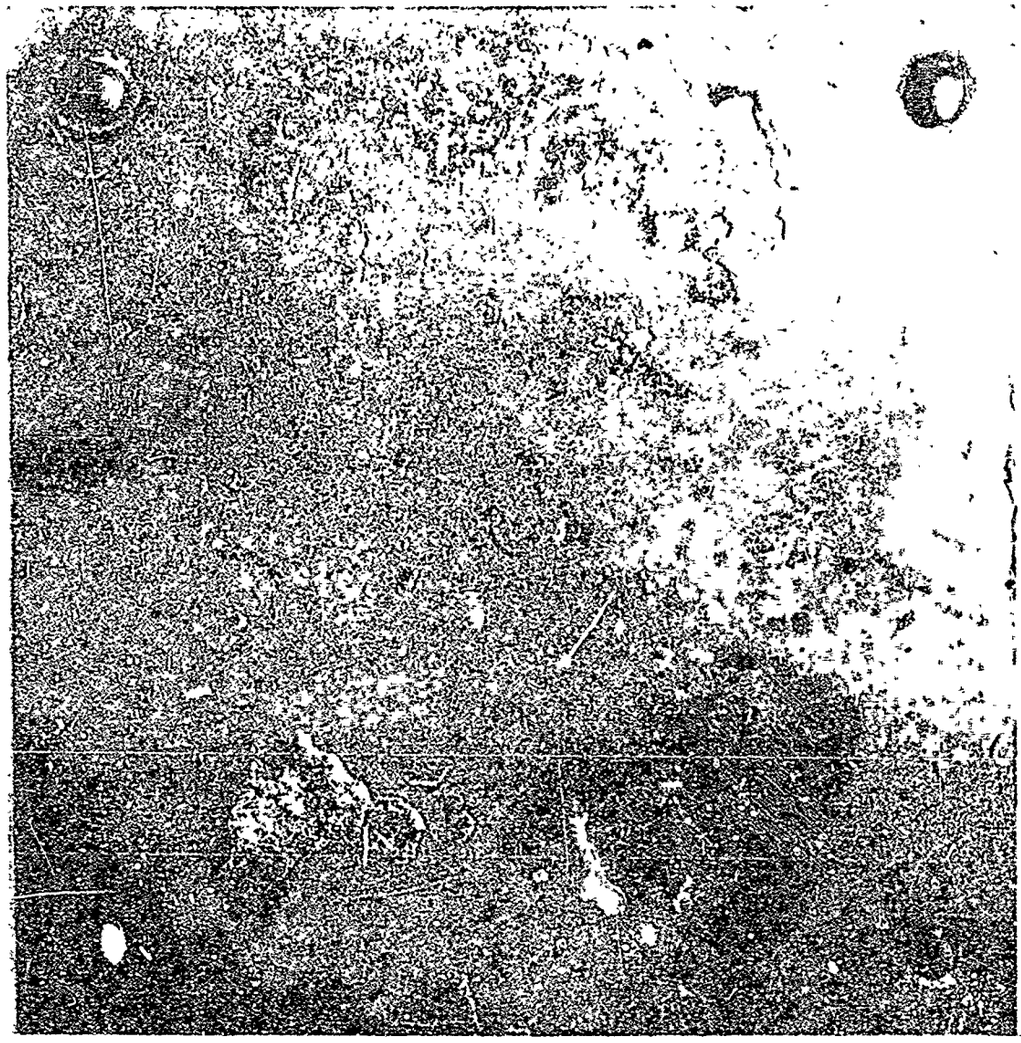


Figure 51. Coating Specimen RSA 64-29-A After Multiple Firing Test Nos. 2, 3, and 4

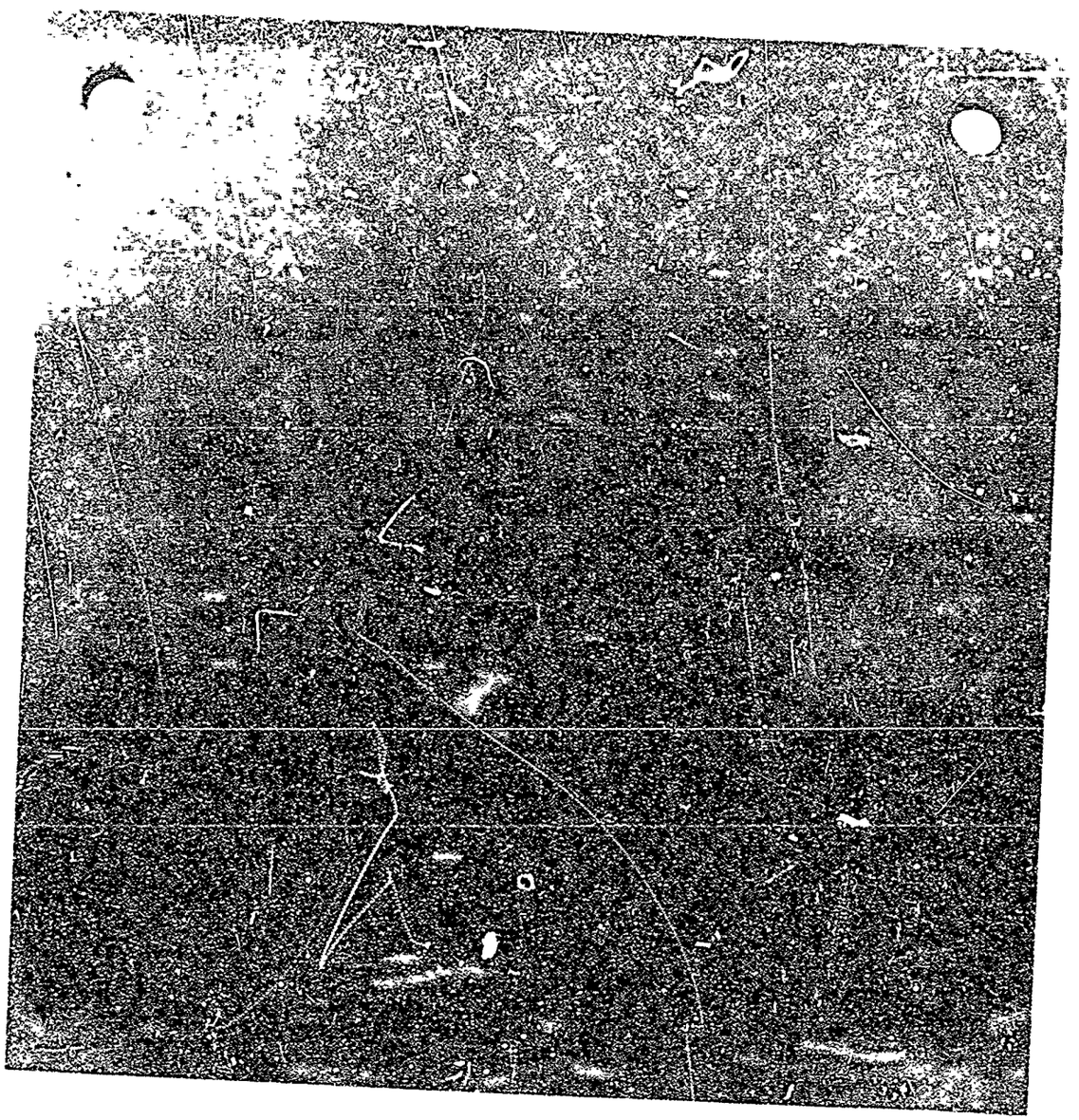


Figure 52. Coating Specimen RSA 64-30-A Before Test No. 1

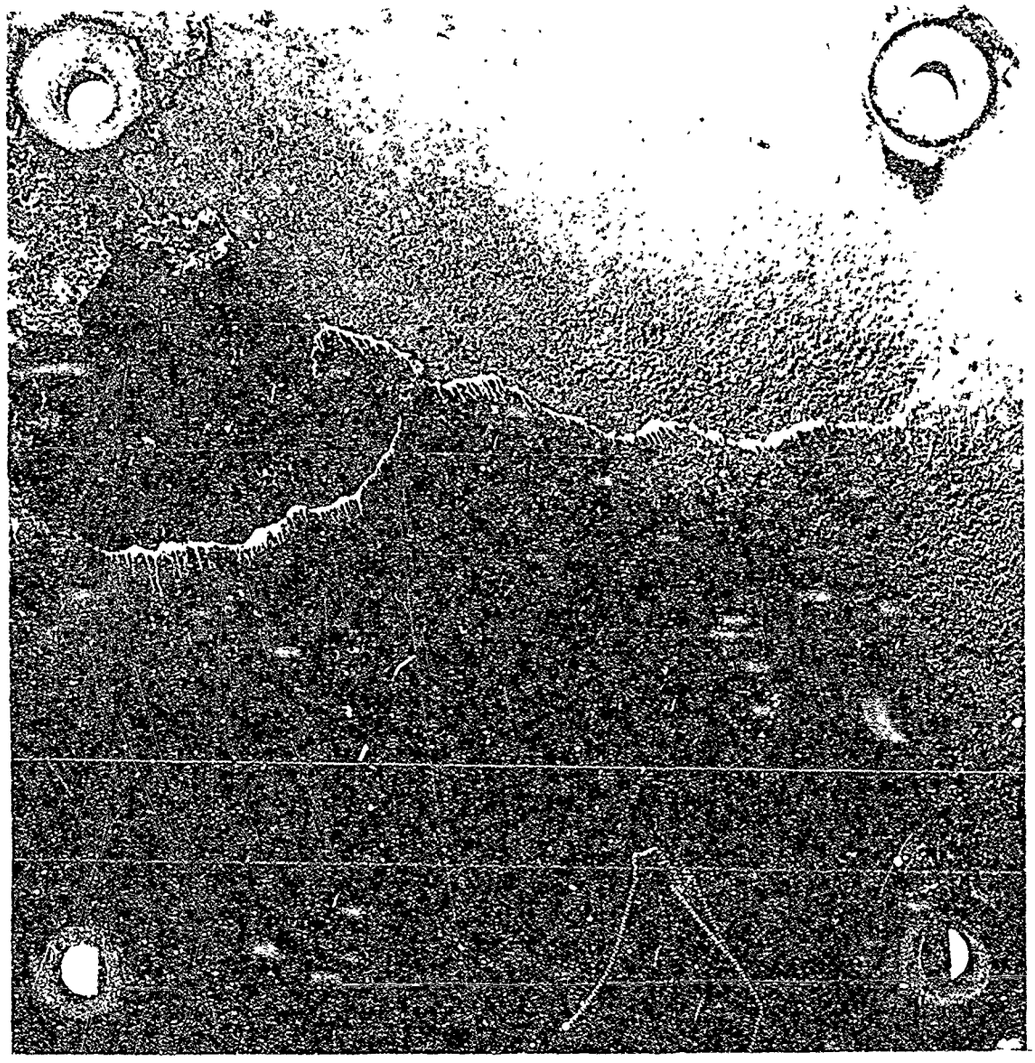


Figure 53. Coating Specimen RSA 64-30-A After Test No. 1

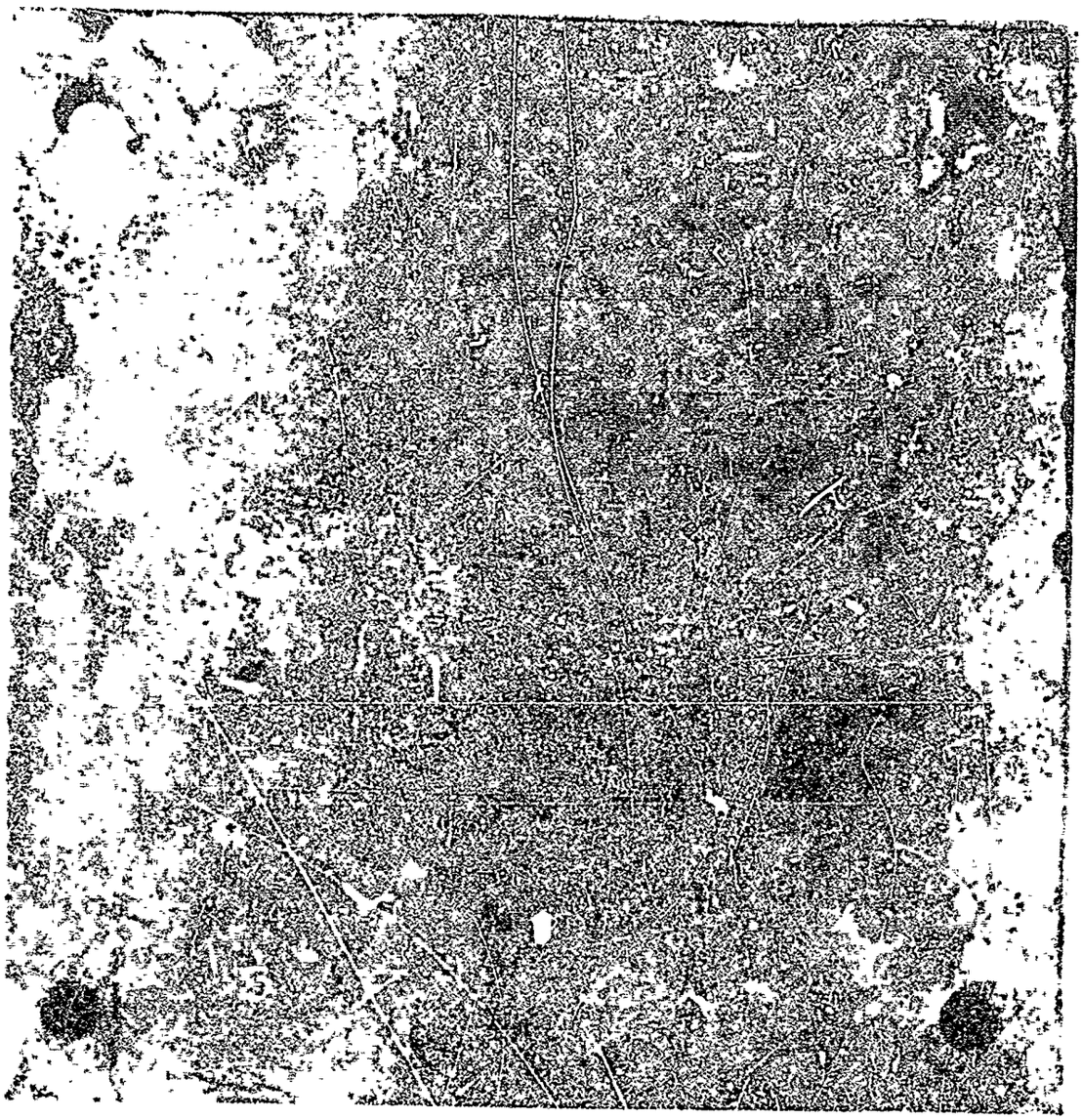


Figure 54. Coating Specimen RSA 64-31-A Before Test No. 1

Figure 55. Coating Specimen RSA 64-31-A After Test No. 1

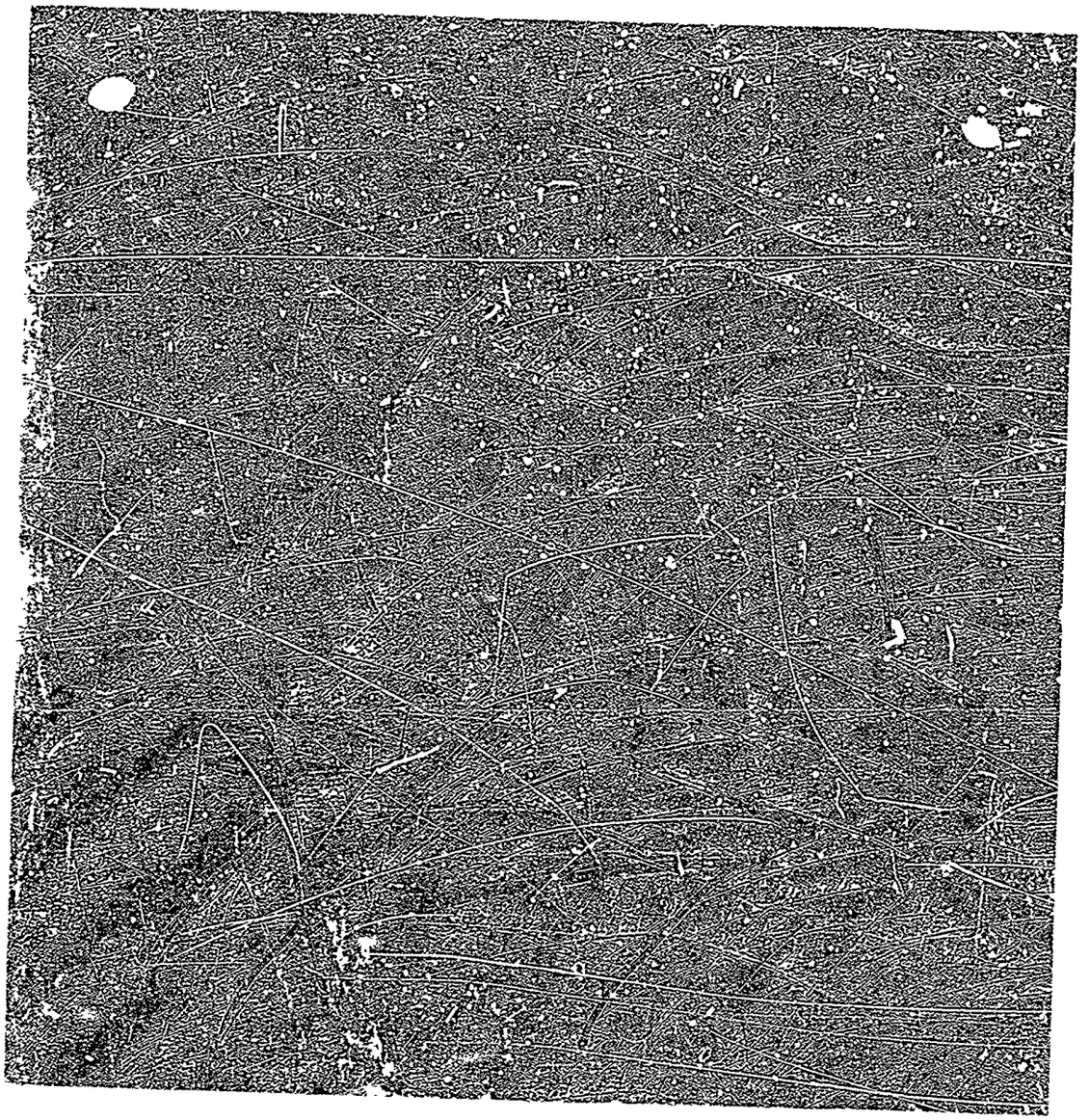


Figure 56. Coating Specimen RSA 64-32-A Before Test No. 1

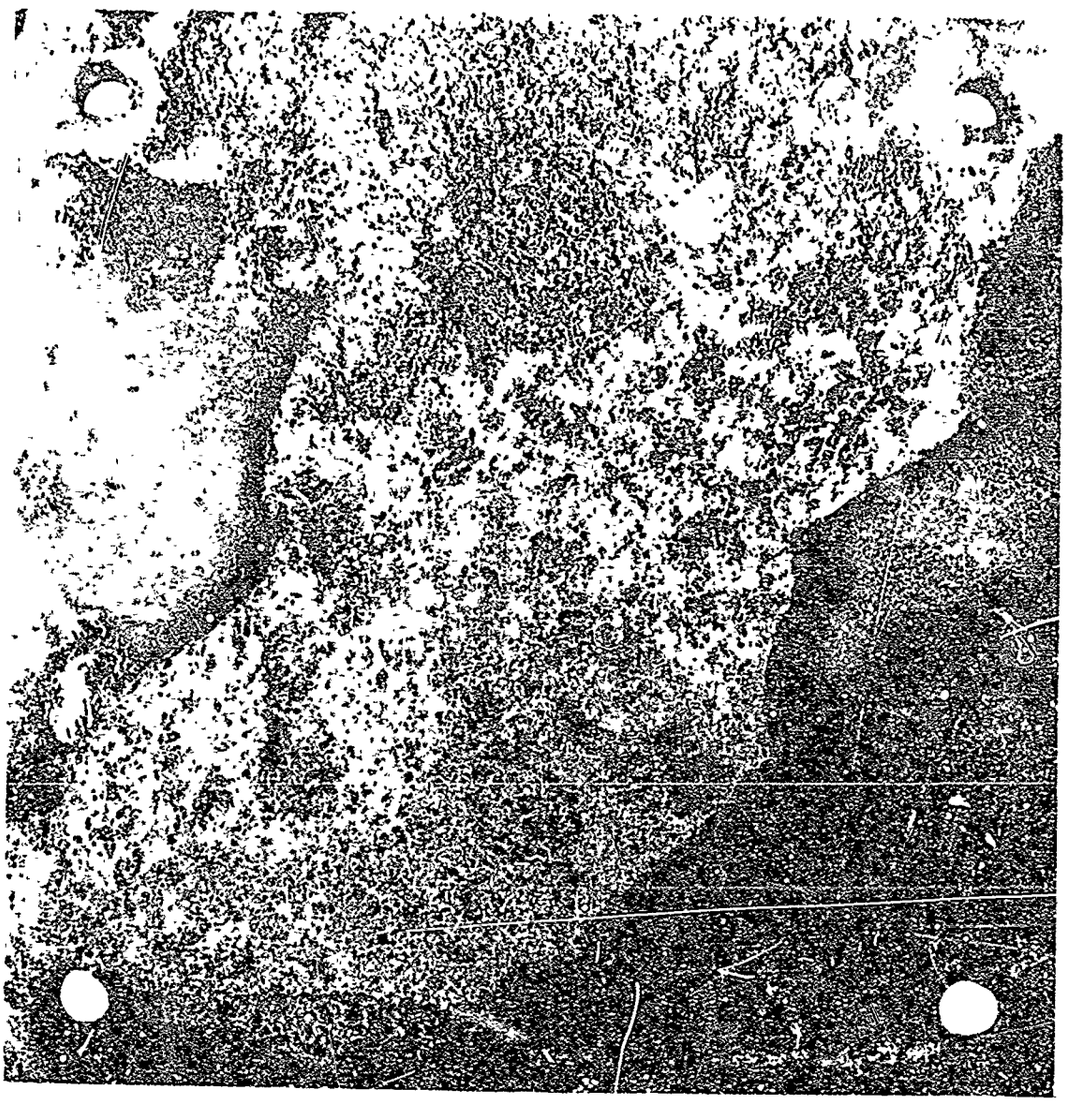
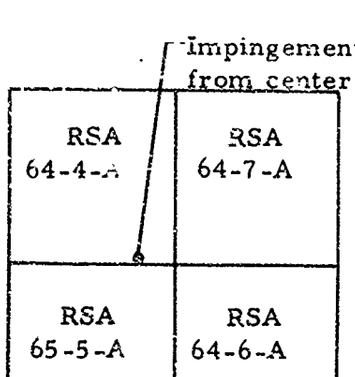
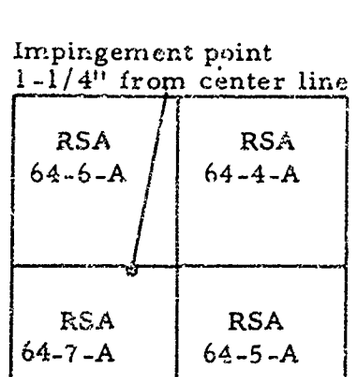


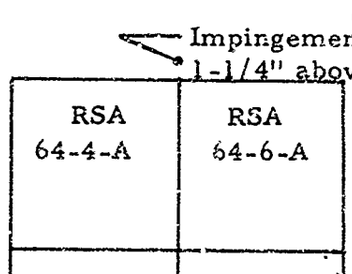
Figure 57. Coating Specimen RSA 64-32-A After Test No. 1



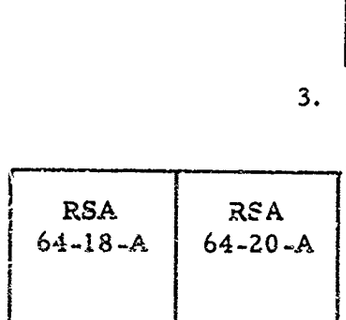
1. STV-9 Firing 11 June 64
   12.0" Distance QE = 45°



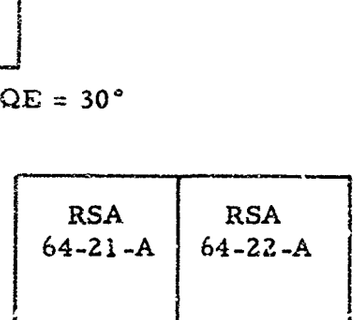
2. CTV-10 Firing 22 July 64, 12.0" Distance QE = 45°



3. RTV-6 Firing Launch QE = 30°
   14.0" Distance
   3 October 64

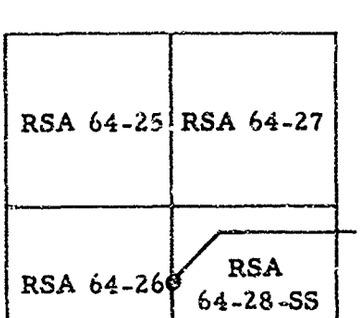


4. BTV-10 Firing Launch
   QE = 48°
   14-3/8" Distance
   11 December 64

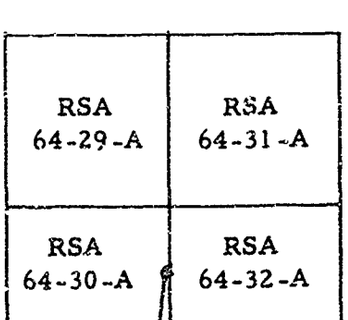


5. GTV-13 Firing
   Launch QE = 40.5°
   13.0" Distance
   17 December 64

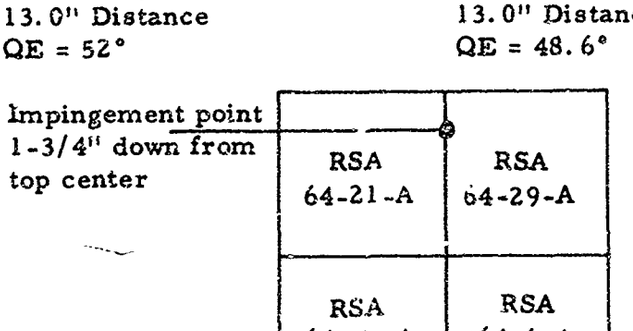
Figure 58. Specimen Arrangements During MAULER Firings



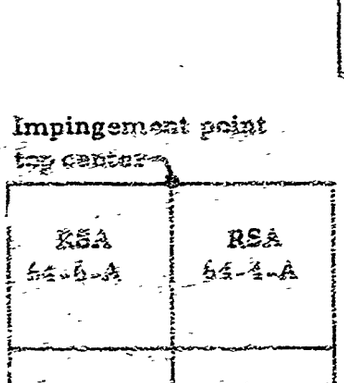
6. BTV-11 Firing
13 January 65
13.0" Distance
QE = 52°



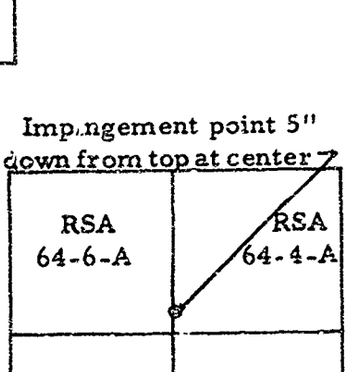
7. GTV-14 Firing
4 February 65
13.0" Distance
QE = 48.6°
Impingement point 3-3/8" below Center
QE = 48°



8. GTV-19 Firing
20 April 65
10.0" Distance
QE = 25.0°



9. GTV-20 Firing 28 April 65
10.0" Distance QE = 23.6°



10. GTV-22 Firing 14 June 65
14.75" Distance QE = 43.0°

Figure 58 (Concluded)

Figure 59. Overall View of Weapon

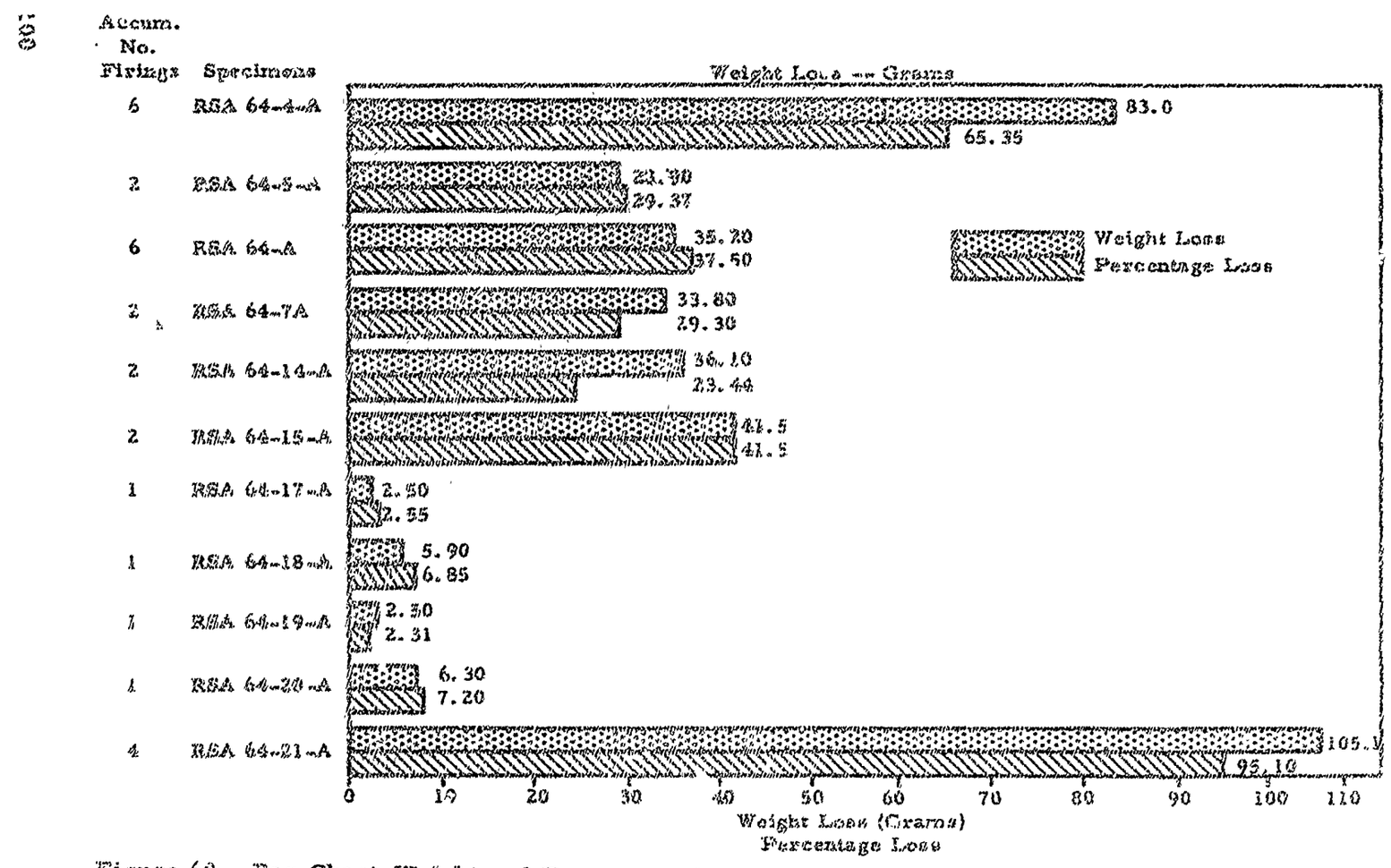


Figure 60. Bar Chart-Weight and Percentage Loss for Twenty-Two Coating Specimens Tested at WSMR

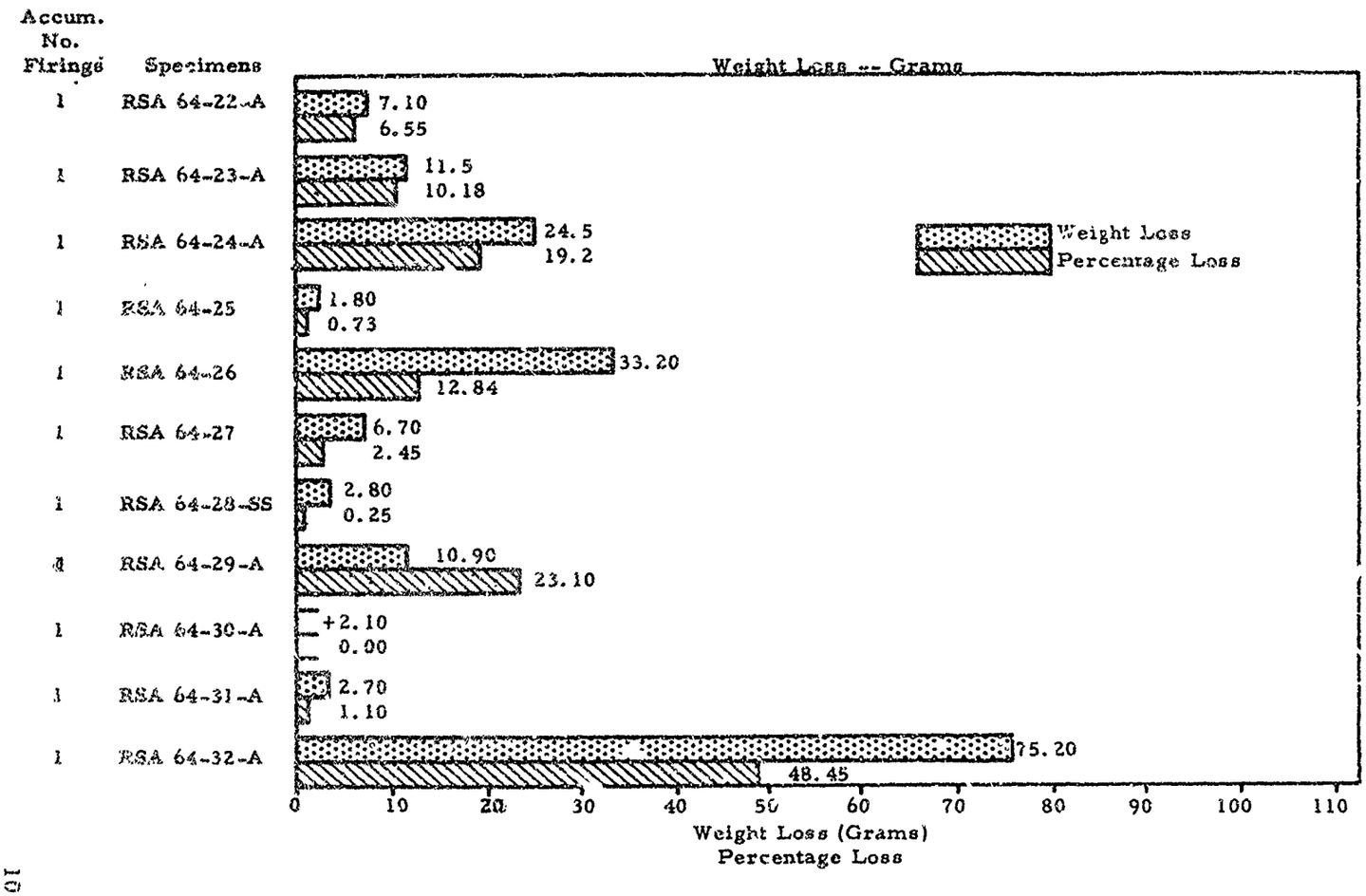


Figure 60. (Concluded)

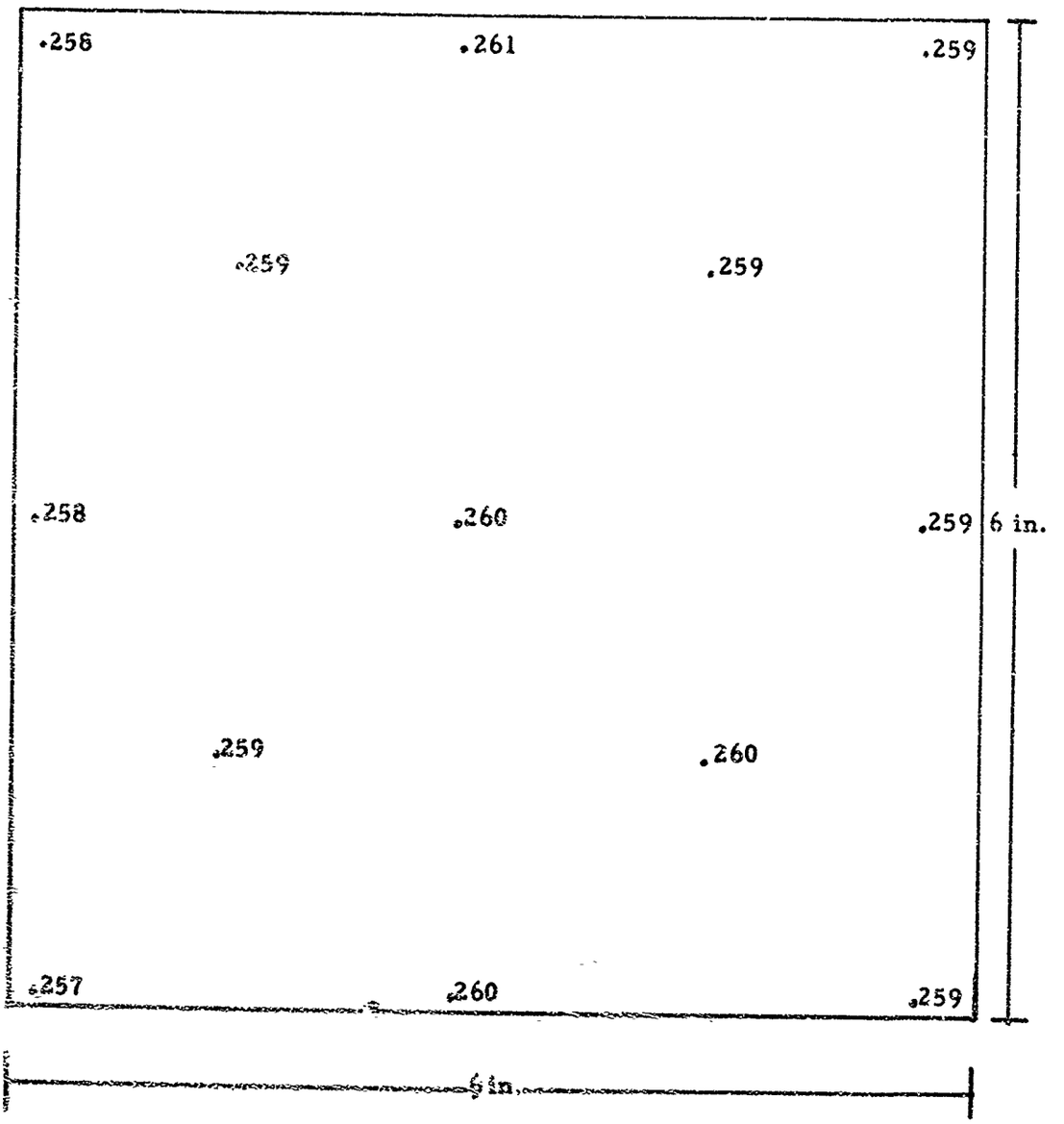
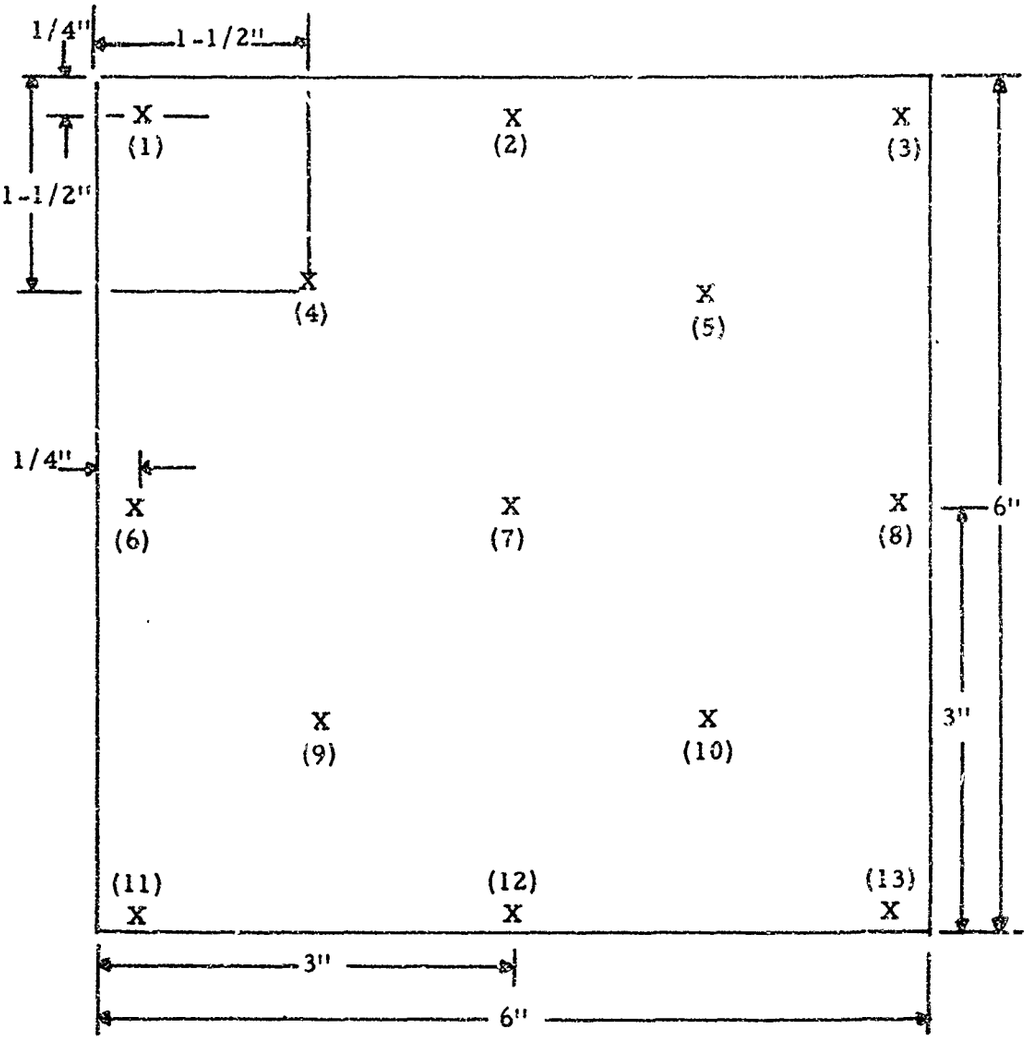


Figure 61. Measurements of Typical Aluminum Control Substrate



Format

All specimens were measured with the engraving on the back, right side up, and all specimens had the coatings facing upward.

The measurements were taken at 13 stations marked by X's on the above diagram.

Note: Station numbers shown in parentheses

Figure 62. Distribution of Specimen Measurement Stations

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